

# THE *DIADEMATUS* GROUP OF THE ORB-WEAVER GENUS *ARANEUS* NORTH OF MEXICO (ARANEAE: ARANEIDAE)

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## ABSTRACT

Among our commonest spiders are the large *Araneus* orb-weavers. Eighteen species are found north of Mexico. They are redescribed, their diagnostic characters illustrated, their ranges mapped, and notes on their habits recorded. Three species turned out to be new: *A. washingtoni* from northeastern U. S. and eastern Canada; *A. yukon* from Yukon Territory; and *A. pinna* from the Southwest.

## INTRODUCTION

Among the species included in the present revision are some of the commonest spiders of North America, although several *Araneus* species are quite rare. Collections were examined not only to get an idea of the variation and distribution of common species, but also with the hope of finding members of the rarer species. The enormity of the collections available slowed down the work immensely.

Because of the urgent need for identification and information on the distribution of the common spiders, I am presenting separately the *diadematus* group of the genus *Araneus*, some members of which have never been illustrated before. It may take many years before I have examined types of all names of the numerous genera placed within the family and the many species described in the genus *Araneus* in the Americas. At present I do not know the limits of the genus and have not decided whether certain species are best included in the genus *Araneus*.

The recognition of reliable diagnostic morphological features of species was one of the critical questions to be resolved. My conclusions agree entirely with those of Grasshoff (1968), but differ from those published by Archer (1951a, b). Archer thought that the species can be diagnosed by the shape of one single sclerite of the male palpus, the median apophysis, and the ventral view of the scape and epigynum of the female. Perhaps these structures will prove of value in differentiating genera; they certainly are of quite limited value for species diagnosis. Also, I agree with Grasshoff that leg spines have doubtful value in separating males of *Araneus* species; they are extremely variable within populations (L. D. Carmichael, in manuscript).

As in my revisions of theridiid spiders, long established names of common species were kept; changing them does not make sense.<sup>1</sup>

<sup>1</sup> I am following the purpose of the *International Code on Zoological Nomenclature* as expressed in its Preamble, although other authors have occasionally in my opinion interpreted individual provisions out of the context to obligate the changing of names. For many common North American species older names are available, but these often have doubtful application as the types have been lost, and interpretation of the usually inadequate description depends on the experience of the reader. Doubtful also are many of the names used by Chamberlin and Ivie (1944) in

In this study the work of the late Dr. H. Wielehle on European spiders has been of tremendous help, as has also the recent study on variation and morphological criteria of several European *Araneus* species by Grasshoff (1968).

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their attempt to resurrect names of Walckenaer for the manuscript illustrations of Abbot. Subjective judgment has to be used in interpreting these rather primitive illustrations of the dorsal aspect of spiders, the types of these names. While other biologists may feel sure of their judgment in these doubtful cases, I am not, and after having obtained copies of Abbot's drawings I find that I disagree with many of the Chamberlin and Ivie assignments; many are obviously in error (Levi and Levi, 1961). The Statute of Limitations (Art. 23b) permits us now to assign many of these uncertain ancient names to the status of obsolete names, should they threaten familiar names that have been in common use for more than 50 years. Like any other tool used by the taxonomist, the *Code* has to be used with common sense.

My request to the Commission to resolve by plenary power the problem of the two family names, Araneidae versus Argiopidae, has been withdrawn because only a few, often those in opposition and those with least experience in taxonomy and nomenclature, state their opinions in writing to the Secretary. However, the non-controversial request to place the name *Argiope* on the *Official List of Generic Names in Zoology* has not been withdrawn. Although sent to the Secretary of the Commission in May 1967, it has not been printed yet. Once printed the name is

protected by Art. 80 of the *Int. Code Zool. Nomencl.*

Instead of submitting the problem of the family name to the Commission, I have circulated a request for the opinion of colleagues. The poll included, of course, nontaxonomists working with orb-weavers. A majority of correspondents favored Araneidae (Araneidae, 43; Argiopidae, 29; Argypidae, 1; outside of North America, Araneidae, 28; Argiopidae, 25; Argypidae, 1). I will continue to use the name Araneidae.

The problem of the spelling of spider generic names is puzzling. The *Code* (Art. 32) now considers incorrect the emendations of spellings by Thorell, almost universally adopted for 100 years. Changing the names now would conflict with Art. 23b (since the incorrect emendations are junior objective synonyms, Art. 33a), and also with the purposes of the *Code* and would certainly be wrong. Thus it seems to me that we have to follow the long accepted spellings of generic names as also generally adopted by Bonnet in the *Bibliographia Araneorum*, and attempt to bring critical cases to the attention of the Commission. It is possible that the pertinent paragraphs of the *Code* might be clarified by a future International Congress to avoid unnecessary name changes.

**Araneus Clerck<sup>1</sup>**

*Araneus* Clerck, 1757, Svenska Spindlar, p. 15.

Type species designated by Simon, 1893, Histoire Naturelle des Araignées, 1: 829, *A. angulatus* Clerck. But the type is said to be *A. diadematus* Clerck by Petrunkevitch, 1928, Trans. Connecticut Acad. Sci., 29: 136 and Bonnet, 1955, Bibliographia Araneorum, 2: 408, although the type species is correctly stated to be *A. angulatus* by Petrunkevitch, 1911, Bull. Amer. Mus. Natur. Hist., 29: 255 and by Bonnet, 1950, Bull. Soc. d'Hist. Natur. Toulouse, 85: 1-9.

*Aranea* Linnaeus, 1758, Systema Naturae, 10th ed. p. 619. The only genus of spiders; *A. diadema* is listed first. No valid type designation seems to have been made previously, thus I here designate *A. diadema* Linnaeus. The generic name *Aranea* has always assumed to be a synonym for *Araneus* Clerck.

*Epeira* Walckenaer, 1805, Tableau des Aranéides, p. 53. Type species designated by Latreille, 1810, Considérations Générales, p. 424, *Aranea diadema* Linnaeus; a second designation is by Thorell, 1869, On European Spiders, p. 53, *Epeira diademata* (Clerck). In 1928 Petrunkevitch (Trans. Connecticut Acad. Sci., p. 136) indicated that *E. cornuta* (Linnaeus) [sic] was the type. Presumably he meant *Araneus cornutus* Clerck.

*Neopora* Simon, 1864, Histoire Naturelle des Araignées, p. 261. A name for a subgenus. The type species is *N. diadema* (= *Araneus diadematus* Clerck) designated by Bonnet, 1958, Bibliographia Araneorum, 2: 3054.

*Burgessia* McCook, 1894, American Spiders, 3: 182. A subgenus for the group comprising *corticaria*, *miniata*, *bonsallae*, *mayo*, *bispinosa*, *pacifica* as well as *forata*, *luteata*, and *juniperi*. The type species is *Epeira corticaria* (Emerton) (= *Araneus corticarius*) here designated. Bonnet, 1955, Bibliographia Araneorum, 2: 917.

<sup>1</sup>Although the starting point of zoological nomenclature is Linnaeus' *Systema Naturae*, 10th edition, with the arbitrary date of 1 January 1758, the work of C. Clerck, 1757, *Svenska Spindlar*, published before, is an exception permitted by Article 26 of the old *International Code on Zoological Nomenclature* passed at the XIII International Congress of Zoology of 1948. After the XV International Congress of Zoology in London in 1958 adopted a new Code (1961), Clerck's *Aranei Succici* was placed on the *Official List of Accepted Works* by Direction 104 of the International Commission on Zoological Nomenclature [1959, Bull. Zool. Nomencl., 17(3-5): 89-91].

was in error when he said that McCook failed to include species in the subgenus.

*Euaranea* Archer 1951, Amer. Mus. Novitates, 1487: 34. Type species for new subgenus; *Aranea cavatica* (Keyserling) by original designation.

*The structure of Araneus genitalia.* The terms used for the sclerites of the palpus are those of Comstock (1910), which have become widely used. I used them in the revisions of Theridiidae and of *Argiope* (1968) and they were also used by Grasshoff (1968).

No terms are in general use to describe the female genitalia; I here follow Grasshoff. The epigynum has a prominent *scape* (Fig. 1). The scape is attached to the *base*. Below and behind the base are a pair of *basal lamellae* which are large and extend on each side of the epigynum of *Araneus marmoreus* (Figs. 1-3). The slit-like openings are on the venter and lead into a funnel which continues posteriorly but is partly open on one side as a *groove*. The groove, as can be seen in cleared or macerated preparations, runs into a funnel-shaped chamber toward the middle of the base and then bends toward the outside and continues under the lateral sclerites (crosshatched in Figs. 1-3). In *A. diadematus* a median posterior sclerite (Fig. 36) covers the grooves, while the funnels are more or less open posteriorly in *A. marmoreus* (Fig. 3).

The palpus of *Araneus* has a large *terminal apophysis* (term. apoph., Figs. 4-6, 8), a sclerite below the *subterminal apophysis* (subterm. apoph., Figs. 4-6, 8), and *distal hematodocha* (dist. hemat.) that are absent in *Argiope* and *Gea* (Levi, 1968).

*Species differences.* Archer (1951) described and pictured only the median apophysis of the palpus (med. apoph. in Figs. 4-6, 8) and the scape of the epigynum. He erected numerous araneid genera on the basis of the shape of the median apophysis. Unfortunately, the median apophysis turns out to be unreliable for separating species of *Araneus* and is pre-

sumably a poor character for separating genera. Related species often have a similar median apophysis (see *A. gemma* group, Figs. 199, 211, or *A. saevus* and *A. diadematus*, Figs. 38, 55). There are also individual differences in this structure within species (e. g., *A. nordmanni*, Figs. 61, 63, 65, 67). This unreliability of the median apophysis as a species specific character is of interest in view of its definite function in copulation: its median spine takes hold of the tip of the scape of the epigynum (van Helsdingen, 1965; Grasshoff, 1968). The form of the scape also varies among individuals of a species.

The distance between the spine and the distal spine or ridge on the median apophysis varies in different species with the length of the epigynal scape. The spine is close to the distal end of the median apophysis in species having a short scape (*A. gemma*, *A. gemmoides*, *A. pima*). The distance is large in those having a long scape (*A. bicentenarius*, *A. andrewsi*, *A. diadematus*, and *A. saevus*). In the related genus *Eriophora*, in which the particularly long scape reaches to the spinnerets, the scape is matched by a shift in position and elongation of the median apophysis.

The shape of the conductor is of diagnostic value only in some species: it is an unusually large sclerite in *A. corticarius* (Fig. 120), and a very small, narrow one in *A. trifolium* (Fig. 179). The conductor in copulation embraces the scape of the epigynum, facing the median apophysis, forming a track on which the scape can glide in two directions.

Of far greater diagnostic value in separating species are the shapes of the embolus and terminal apophysis (term. apoph. in Figs. 4-6, 8), structures easily seen but often slighted in illustrations of araneid species. (Seen in all illustrations of the mesal view of the palpus in this paper.) Part of the embolus enters the female duct system (the left embolus, the left opening and ducts). But during copulation the terminal apophysis comes to lie below the

base of the scape, against the abdomen, and supplies support.

The cap that is present on the embolus of virgin males (Levi, in press) differs in shape in different species. The caps of some species (e.g., *A. illaudatus*) are very large and noticeable.

The paracymbium differs greatly among species within the genera *Meta* and *Zygiella* (Gertsch, 1964), but is similar in almost all *Araneus* species. This only illustrates the difficulty of making generalizations or of attempting to use only one sclerite of the palpus, such as the median apophysis, for species diagnosis in all genera of the family. The paracymbium, during copulation, lies near the base of the median apophysis; it prevents the median apophysis from turning and by hooking into the tegulum border, acts as a stopping wedge between median apophysis and tegulum.

In the female the best diagnostic characters are those of the epigynum. However, the length and wrinkling of the prominent scape varies, perhaps due to different folding. In most species the scape is short; however, in some species it is always long (*bicentenarius*, *andrewsi*, *diadematus*, and *saevus*). The general shape varies among species. The scape may break off during mating in almost any species, and usually is torn off in *A. corticarius* and *A. groenlandicolus*.

The general structure of the base of the epigynum is much less variable and differs more between species than among individuals of a species. As it is undesirable to cut off the scape to view the base, it is best examined in posterior view by pulling the epigynum slightly away from the abdomen. Unfortunately, most authors have not illustrated this posterior view, exceptions being Wiehle (1963) and recently Gertsch (1964) in revising American species of the araneid genus *Zygiella*. The basal lamellae are unfortunately also quite variable among different individuals of a species, as is shown by Grasshoff (1968, p. 46, fig. 41).

However, genitalia are not the only characters. *Araneus corticarius* has highly distinctive abdominal shape and coloration (Fig. 118). It cannot be confused with any other North American species. The cross-shaped arrangement of markings on the dorsum of *A. diadematus* (Fig. 37) is diagnostic in North America, although not in Europe.

The second tibia in males of many species has strong spines and is often bent. Grasshoff (1968, p. 24, fig. 17) illustrated the considerable variation within the four species studied. While the spine pattern is not a good character for separating species of *Araneus* (L. D. Carmichael, in manuscript), the presence or absence of spines and modifications of tibia 2 may be used to separate some species.

The male of most species has a hook on the distal margin of the first coxa (Fig. 183), which fits into a proximal depression on the dorsal surface of his second femur, coupling the legs during mating. The coxal hooks are small and more posterior in some species (*A. gemma*) and absent in others (*A. cavaticus*). A cone or spur is present on the second coxa (Fig. 183) in some species. The hook on the first coxa and the corresponding depression are found in species of many araneid genera and do not seem to reflect close affinity.

Any diagnostic feature of any animal species is subject to variability within a certain range. This is true also of spiders. Curiously, this is denied by some spider specialists who consider any differences in structure (individual or geographic) to represent a "species difference." The variability of many characters of four *Araneus* species of Europe has been beautifully illustrated by Grasshoff (1968). My observations support Grasshoff's completely: while sclerites in the palpus (Figs. 96-99, 103, 104) and all parts of the epigynum show some variation among individuals (Figs. 76-92), nevertheless there are gaps in the variability between species.

*Character displacement.* "Character dis-

placement" is a useful term proposed by Brown and Wilson (1956) for the phenomenon that morphological characters of related species having overlapping ranges show greater difference in the area of overlap than in their allopatric distribution. Examples have been found whenever taxonomic revisions are made and there is abundant material. In my theridiid revisions I found character displacement between *Theridion montanum* Emerton and *T. lawrencei* Gertsch and Archer (Levi, 1957a, p. 72). Specimens of *Steatoda hespera* Chamberlin and Ivie and *Steatoda borealis* (Hentz) are more distinct where the borders of their ranges meet, although I failed to point this out in my revision (Levi, 1957b). *Argiope trifasciata* (Forskål) males have a noticeably smaller palpus in the area of overlap with the very similar *A. florida* Chamberlin and Ivie, which has a larger palpus (Levi, 1968, p. 335, 337).

The possibility of drawing erroneous conclusions by ignoring geographic and individual variation and picking up individual specimens is best shown in *Araneus nordmanni*. *Araneus nordmanni* is found in the same habitat, on forest trees, as the dark-colored *A. saevus*. Where the ranges of the two species overlap, *A. nordmanni* is rarely dark, and shows little variation in size and shape. However, outside the range of *A. saevus*, in the southern part of the range of *A. nordmanni*, it is often black, it varies in size, and in no two males are the embolus (Figs. 69-75) and median apophysis exactly the same shape. *Araneus nordmanni* is largest in the southwestern part of its range. By looking only at the median apophysis of the palpus of a few specimens and noting differences in size and color, Archer described *A. pseudomelaena* from the southwest and *A. darlingtoni* from southeast. The differences Archer observed are there, but by examining larger samples one can easily see that the differences are within the variation of *A. nordmanni*. Perhaps the differences among

populations in the southwest are emphasized by the isolation of the habitats in which this forest species can survive.

*Introgession.* Of considerable interest is the *Araneus gemma* group of species, including five species north of Mexico. The eastern *A. cavaticus* is very distinct, but is closest to *A. gemma* of the Pacific coast. There is the widespread *A. gemmoides* from the central states and provinces to the Pacific coast. All these species build large webs on barns, houses, and porches although their original habitat may have been cliffs and entrances to caves. In addition there are *A. pima* in Utah and Arizona, and *A. illaudatus* from Arizona to Texas. The habitats of the last two are uncertain, although they probably are also found on buildings.

*Araneus gemma* McCook was split by Chamberlin and Ivie into three species: *A. gemma*, *A. gemmoides*, and *A. pirus*. With few specimens on hand the judgment was sound. However, any series shows that *A. gemma* is quite variable, as is *A. pirus*; furthermore, at times *A. gemma* is collected with *A. gemmoides*. Some females are intermediate and cannot be assigned to either species (Figs. 215–217). Populations of *A. gemmoides* are relatively uniform except for coloration in the area of overlap with *A. gemma*. Apparently the two species hybridize and introgression is taking place with gene flow into the *A. gemma* population. It is known that males may try to mate with females of the wrong species. Broken-off embolus caps are at times found on the epigynum of a different species. It is especially common to find large *A. illaudatus* tips in the epigynum of *A. pima*. Apparently the cross of *A. gemmoides* × *A. gemma* is fertile. This would produce a potentially interesting study. It is not followed up here.

It is not uncommon to collect females with the wrong males. This happened to as careful a naturalist as Emerton. Grasshoff (1964) reports that males of *Araneus diadematus* will court females of *A. palli-*

*dus* (Olivier) and tiny *A. pallidus* males will court *A. diadematus*. In courtship the male plucks web threads in a rhythm characteristic for his species. Females do not respond to the plucking of a male of the wrong species. One male of *A. diadematus* gave up only after five hours of courting a female of *A. pallidus*.

*Habits.* All North American *Araneus* of the *diadematus* group have similar life histories. There is one generation, which matures in summer, mates in summer, and dies in fall after making a loose fluffy egg sac (Plate 1). Spiderlings leave the egg sac in spring (*A. diadematus*).

The virgin male has the embolus capped (Levi, in press). The function of the cap is not known, but it is not believed to transmit sperm although a duct is at times visible. Males are known to mate several times and to survive mating. It has been suggested that mating before sperm induction, as observed in some spiders, may remove the cap and permit the embolus to function (Kullmann, van Helsdingen, personal communication). The cap is diagnostically different in each species. About half the males in collections are virgin and still have the cap, half have mated and have lost it. Virgin males wandering in search of a mate may be more likely to be collected.

In all collections examined, only one male was marked as having been killed and eaten by a female *A. diadematus*. The male when examined turned out to be an *A. cavaticus*, not the partner of the female. However, Grasshoff (1964) reports that the female of *Araneus pallidus* has to bite into the male's abdomen to permit holding on during copulation. In one case the female, feeding on an insect, was prevented from biting; the male could not hold on to the female, slid off, and was wrapped in silk like prey.

All species make an almost vertical orb web with about 18–30 radii, with a retreat above to the side of the web in leaves, bark, or lichens and connected with the



Plate 1. Egg sac of captive *Araneus pima* sp. n. from Arizona

hub by a signal line (Plate 2). During the day the spider rests in the retreat, at night usually in the center. The center has an irregular mesh. *Araneus diadematus* is more likely than other species to be found in the center of the web at daytime. Although all species mature at the same time, their variation in size is reflected in the diameter of the orb and the size of the prey handled. Also each species seems to have its own habitat, some preferring forests (*A. saevus*, *A. nordmanni*, and the small *A. corticarius*), some meadows (*A.*

*trifolium*, *A. marmoreus*), city gardens (*A. diadematus* in North America), buildings or cliffs (*A. cavaticus* group). *Araneus bicentenarius*, often brightly colored, makes its retreat among lichens (Plate 3), the color of which it matches.

Species living in the open in herbaceous vegetation tend to have an oval abdomen (*A. marmoreus*, *A. trifolium*), while those living on trees and cliffs have humps (*A. nordmanni*, *A. saevus*, *A. cavaticus*). The adaptation of this curious correlation is not known, but is also believed true of



Plate 2. (Top) Web of *Araneus cavaticus* (Keyserling) powdered with corn starch, West Virginia. (Photo by W. A. Shear.)  
(Bottom) Web of *A. gemmoides* Chamberlin and Ivie with adult female, Wisconsin.





Plate 3. *Araneus bicentenarius* (McCook) in retreat among lichens, West Virginia. Both spider and the lichens are the same shade of green. (From Ektachrome photo by W. A. Shear.)

European species. It has been suggested (W. S. Shear, personal communication) that only those that have a retreat in curled up leaves lack humps.

Western *A. gemmoides* and some *A. gemma* have black bars on the venter, which are distinct "eyes" in *A. pima* (Plate 4). I assume that when disturbed the spider zooms down its signal thread to appear at the center of the orb web. In South America I watched an araneid make maximum use of its ventral spots, which in the particular individual observed were in the shape of a face.

The habitat observations reported here are gleaned from the labels on vials. Only mature individuals were used. Most checklists and literature on habits are unreliable because the species determinations are in

doubt and often wrong. The specimens usually have not been turned over to a museum for safe keeping as voucher specimens. In mapping distributions, only specimens examined have been used.

#### KEY TO FEMALES

- 1a. Abdomen with humps or angular anteriorly (Figs. 21, 37, 118) ..... 6
- 1b. Abdomen oval to spherical, without humps or anterior angles (Figs. 144, 177) ..... 2
- 2a. Posterior lamellae of epigynum showing on each side in ventral view as large curved folds; scape overhanging a depression bordered on each side (Figs. 1, 107) ..... *marmoreus*
- 2b. Posterior lamellae not visible in ventral view or, if visible, scape not overhanging a depression bordered on each side ..... 3
- 3a. Scape of epigynum with more or less parallel sides, very rarely broken off (Figs. 138, 174) ..... 4
- 3b. Scape of epigynum tapered toward tip, or often broken off (Figs. 159, 167) ..... 5
- 4a. Legs banded; a bordered depression on each side of epigynal scape in ventral view (Fig. 174); no median keel in posterior view (Fig. 176) ..... *trifolium*
- 4b. Legs not banded; base of epigynum a domed area truncate on the posterior side; openings posterior and separated by a keeled septum (Figs. 140, 142) ..... *iviei*
- 5a. Scape of epigynum widest at base; on each side of scape a shallow depression with a narrow rim (Fig. 167) ..... *yukon*
- 5b. Scape, if present, widest close to its middle; scape hiding ventral depression (Fig. 159) and if scape is broken, rims wide (Fig. 162) ..... *groenlandicolus*
- 6a. Abdominal humps projecting toward sides; usually a transverse line between humps anterior of which abdomen is usually dark, posterior light (Fig. 118) ..... *corticarius*
- 6b. Humps dorsal, transverse markings not as contrasting ..... 7
- 7a. Scape long, at least twice as long as width of base ..... 8
- 7b. Scape short ..... 12
- 8a. Scape coiled (Fig. 52); southwest ..... *santarita*
- 8b. Most of scape straight (Figs. 45, 48) ..... 9
- 9a. In posterior view of epigynum there is a median light groove (Figs. 17, 20, 29) ..... 10
- 9b. No such groove in posterior view ..... 11
- 10a. Venter of groove (toward scape) dark and swollen, epigynal lamellae on each side large (Fig. 29); Pacific coast ..... *andrewsi*
- 10b. Venter of groove not swollen toward scape, lamellae small (Figs. 17, 20);



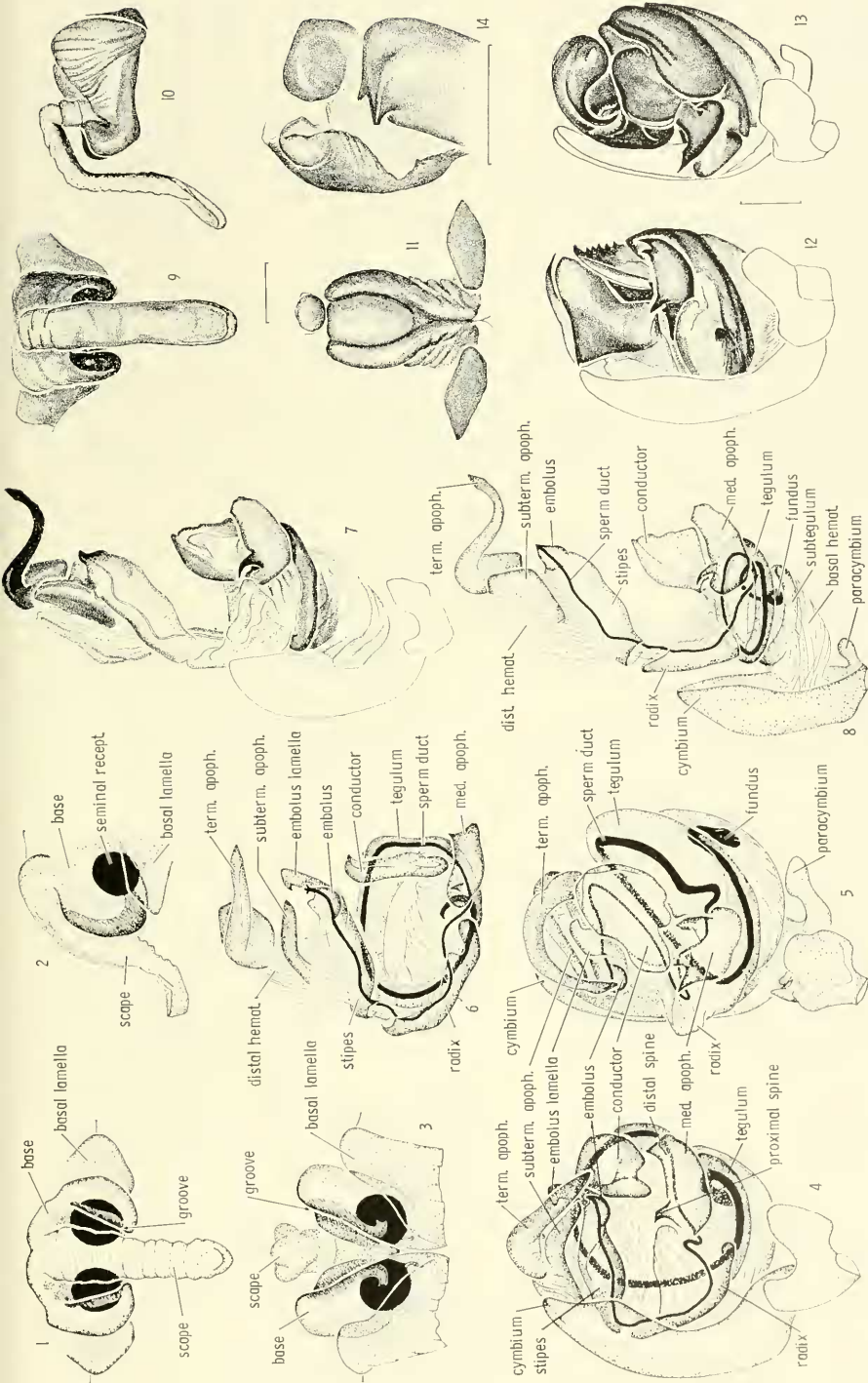
Plate 4. *Araneus pima* sp. n. showing eye spots on venter of abdomen.

- Canada, eastern United States to South-west ..... *bicentenarius*
- 11a. Spider dark, abdomen very dark, black, usually with a white lanceolate cardiac mark on abdomen (Fig. 51); forests; epigynum as in Figs. 42, 44, 45, 47, 48, 50 ..... *sacvus*
- 11b. Spider light, abdomen almost always with light dorsal marks in shape of a cross (Fig. 37); city gardens; epigynum as in Figs. 34, 36 ..... *diadematus*
- 12a. Epigynal scape with transverse annuli separated by grooves (Figs. 123, 124, 187, 188) ..... 13
- 12b. Epigynal scape lacking transverse annuli (Figs. 207, 224, 233) ..... 14
- 13a. Scape twisted (Figs. 123, 124); base on each side of scape with a diagonal rim enclosing the median depression (Fig. 123); Newfoundland to New Hampshire ..... *washingtoni*
- 13b. Scape straight (Figs. 187, 188); rims of depression hidden by scape (Fig. 187) ..... 15
- 14a. Width of scape more than half width of epigynum (Fig. 187); epigynum in posterior view with median triangular sclerite (Fig. 189); Eastern United States and Canada, on overhanging cliffs, common on buildings ..... *cavaticus*

- 14b. Width of scape less than half base of epigynum (Figs. 87, 90); epigynum in posterior view with heart-shaped depression (Figs. 89, 92); widespread in forests ..... *nordmanni*
- 15a. Anterior end of epigynal scape constricted (Fig. 233); Texas and southwest ..... *illaudatus*
- 15b. Anterior end of scape is wide, scape tapered toward tip ..... 16
- 16a. Epigynum and scape very small, scape triangular (Fig. 195); widespread in central Canada and United States to Pacific coast ..... *gemmoides*
- 16b. Epigynum and scape otherwise (Figs. 203, 205, 218); Pacific coast and Southwest ..... 17
- 17a. Scape without lateral rims (Figs. 218, 221); a deep transverse groove in posterior view (Figs. 220, 223); California to Texas ..... *pima*
- 17b. Scape with lateral rims, very variable (Figs. 203, 205); transverse groove very narrow if present (Figs. 204, 206); Pacific coast ..... *gemma*

KEY TO MALES

- 1a. First coxa with a hook on distal margin facing second coxa (Fig. 183) ..... 2
- 1b. First coxa without hook on distal margin ..... 9
- 2a. Conductor of palpus with teeth around margin (Figs. 23, 24, 31); median



Figures 1-3. Structure of epigynum of *Araneus mormoreus*, a transparent diagram. 1. Ventral. 2. Lateral. 3. Posterior.

Figures 4-6. Structure of left palpus of *A. mormoreus*, a transparent diagram. 4. Mesal. 5. Ventral. 6. Expanded.

Figures 7-8. Structure of left palpus of *A. soevis*. 7. Expanded. 8. Expanded, a transparent diagram.

Figures 9-14. *A. angulatus* Clerck (Europe). 9-11. Epigynum. 9. Ventral. 10. Lateral. 11. Posterior. 12-14. Palpus. 12. Mesal. 13. Ventral. 14. Embolus, pulled out, ventral view.

(All size indicators, 0.5 mm)

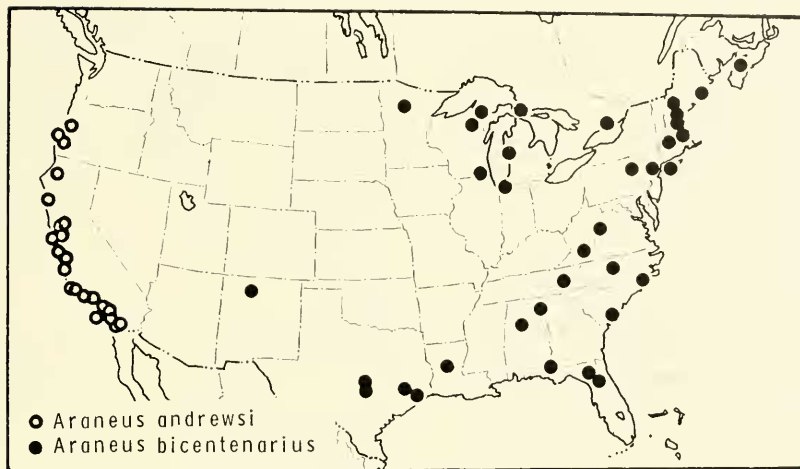
- apophysis with at least 2 distal spines (Figs. 23, 32) ..... 3
- 2b. Conductor of palpus smooth around margin; median apophysis with a keel on distal edge (Figs. 4, 110) ..... 4
- 3a. Terminal apophysis with drawn-out tip (Figs. 31, 32); teeth around edge of conductor subequal (Fig. 31); Pacific coast ..... *andrewsi*
- 3b. Tip of terminal apophysis an acute triangle (Figs. 23, 24); first tooth on embolus side of conductor noticeably larger than others (Figs. 23, 24); Canada, eastern U. S. to Southwest ..... *bicentenarius*
- 4a. Second coxa with spur (Fig. 183) ..... 6
- 4b. Second coxa without spur ..... 5
- 5a. Palpal conductor unusually large (Fig. 120); in mesal view median apophysis about 3 times as long as wide (Fig. 119); Pennsylvania to Alaska ..... *corticarius*
- 5b. Palpal conductor of normal size (Fig. 128); median apophysis about 2 times as long as wide (Fig. 127); Newfoundland to New Hampshire ..... *washingtoni*
- 6a. Terminal apophysis paralleled by a long subterminal apophysis (Figs. 4, 96-99, 103, 104, 110) ..... 7
- 6b. Subterminal apophysis a short stub ..... 8
- 7a. Embolus sclerotized, subcircular at end (Figs. 4, 103, 104, 110); holarctic ..... *marmoreus*
- 7b. Embolus longer than wide as in Figs. 69-75, 96; holarctic ..... *nordmanni*
- 8a. Embolus a curved hook (Figs. 38, 40, 41); apical apophysis short, curved, sickle-shaped (Figs. 38, 39) ..... *diadematus*
- 8b. Embolus otherwise (Figs. 55, 57, 58); apical apophysis a long, strongly curved prong (Figs. 55, 56) ..... *saevus*
- 9a. Inner lamella of embolus a wide projecting plate of larger visible area than narrow conductor (Fig. 179); embolus with distal notch (Figs. 178, 180, 181) ..... *trifolium*
- 9b. Inner lamella of embolus, if projecting, with visible part always much smaller in area than conductor (Fig. 172); embolus otherwise ..... 10
- 10a. Second tibiae modified by being swollen or curved (Fig. 184) ..... 11
- 10b. Second tibiae straight, not swollen ..... 12
- 11a. Median apophysis with slender, graceful proximal spine and distal projections with strong, straight spines, the lower one with a dentate edge (Figs. 171, 172) ..... *yukon*
- 11b. Median apophysis with proximal spine stout and distal projections both bent out at right angles to main axis of median apophysis (Figs. 164, 165) ..... *groenlandicolus*
- 12a. Terminal apophysis a sclerotized prong, widened just before tip (Figs. 145-148); conductor with a pocket on lateral side (Figs. 146, 148); embolus as in Figs. 145, 149-151 ..... *iviei*
- 12b. Terminal apophysis lightly sclerotized, fleshy, never widened near tip; conductor and embolus of different shape ..... 13
- 13a. Males more than 10 mm total length; proximal spine of median apophysis placed in proximal half of sclerite; distal edge a keel (Figs. 191, 192); eastern United States, Canada ..... *cavaticus*
- 13b. Males less than 9 mm in total length; proximal spine of median apophysis placed close to distal spine (Figs. 211, 212, 238, 239); central, western and southwestern region ..... 14
- 14a. Palpal tibia almost equal in size to bulb (Figs. 199, 200); spines of median apophysis slender; terminal apophysis truncate (Figs. 199, 200); widespread in central and western North America ..... *gemmoides*
- 14b. Palpal tibia less than half area of bulb; spines of median apophysis stout; terminal apophysis more pointed; Pacific states, southwest to Texas ..... 15
- 15a. Embolus pointed (Figs. 211, 214); embolus cap short (Fig. 213) ..... *gemma*
- 15b. Embolus truncate (Fig. 232); embolus cap elongate, pointed (Figs. 231, 240); Texas to California ..... 16
- 16a. Total length 5-11 mm; spines of median apophysis stout (Figs. 228, 229) ..... *pima*
- 16b. Total length less than 4 mm; spines of median apophysis slender, recurved (Figs. 238, 239) ..... *illaudatus*

### *Araneus angulatus* Clerck Figures 9-14

*Araneus angulatus* Clerck, 1757, Svenska Spindlar, p. 22, pl. 1, figs. 1-3, ♀. Type specimens in the Natural History Museum, Stockholm, lost. Locket and Millidge, 1953, British Spiders, 2: 127, figs. 80, 83, ♀, ♂. Bonnet, 1955, Bibliographia Araneorum, 2: 433 (in part).

*Aranca angulata*, — Wiehle, 1931, in Dahl, Die Tierwelt Deutschlands, 23: 52, figs. 4, 5, ♀, ♂. Roewer, 1942, Katalog der Araneae, 1: 795 (in part).

*Note.* Although there are many literature records of this species in North America, all refer to large specimens of various other species (*A. andrewsi*; *A. bicentenarius*; *A. saevus*; *A. marmoreus*; *A. nordmanni*) that had been misidentified. No specimens of *Araneus angulatus* coming from North America have been found in collections.



Map 1. Distribution of *Araneus bicentenarius* (McCook) and *A. andrewsi* (Archer).

The differences between *A. angulatus* and North American species are discussed under *A. bicentenarius*.

The web, described by Wichle (1931) has bridge threads up to 5 m long at 3 m height. The number of spokes averages 21 and the snare region is 40–63 cm across.

### *Araneus bicentenarius* (McCook)

Plate 3; Figures 15–26; Map 1

*Epeira gigas* Leach, 1815, Zoological Miscellany, 2: 132, pl. 109. Female type probably from America in the British Museum, Natural History, examined. (Not *A. gigas*, — Comstock, 1912, 1940, The Spider Book and some other authors<sup>1</sup>.)

*Epeira bicentennaria* McCook, 1888, Proc. Acad. Natur. Sci., Philadelphia, p. 195, figs. 3, 5, ♀. Syntypes from “northwestern Ohio and Allegheny mountains” lost.

*Epeira angulata* var. *bicentennaria*, — McCook, 1893, American Spiders, 3: 186, pl. 10, figs. 3–5, pl. 11, figs. 2–4, ♀, ♂.

*Aranea bicentennaria*, — Archer, 1951, Amer. Mus. Novitates, 1487: 31, figs. 68, 78, ♀, ♂.

*Aranea kisatchia* Archer, 1951, Amer. Mus.

Novitates, 1487: 27, fig. 69, ♀. Female holotype from Grant Parish, Louisiana, in the American Museum of Natural History, examined. NEW SYNONYMY.

*Note.* Leach’s description suggested that his *Epeira gigas* is *A. bicentenarius*. The type of *E. gigas* was found pinned and stuffed with cotton in the British Museum by Mr. D. J. Clark. After placing it in alcohol Mr. D. J. Clark examined the specimen and reported it to be an unusually large specimen of *A. angulatus*; upon comparing it to my drawings he found it to match Figures 18, 19 of a southern *A. bicentenarius*. I have since examined it myself. The name *A. gigas* has been used by some authors for *A. marmoreus*, never before for *A. bicentenarius*. A junior homonym, *Epeira gigas* C. L. Koch, 1830, has been renamed *A. grossus* (C. L. Koch) and belongs to a species also closely related to *A. angulatus*. The spider was collected by McCook in 1882 at the bicentennial of the city of Philadelphia. By misprint the name was spelled with two n’s in the first publication.

*Description.* Female from New Jersey. Carapace dark brown. Sternum dark brown with a lighter, branched mid-longitudinal band. Legs mottled brown with darker

<sup>1</sup>The International Commission on Zoological Nomenclature will be asked to place the name *Epeira gigas* Leach on the Official List of Rejected Names in Zoology and the name *Epeira bicentennaria* McCook on the Official List of Specific Names in Zoology.

bands. Abdomen very dark with folium. Venter dark brown to black, sometimes with a median light area. Abdomen with large humps. The dorsum has small sclerotized spots, the bases of setae, but all setae are short. Total length, 15 mm. Carapace, 5.9 mm long, 5.0 mm wide. First femur, 6.8 mm; patella and tibia, 9.2 mm; metatarsus, 5.4 mm; tarsus, 1.8 mm. Second patella and tibia, 8.4 mm; third, 5.0 mm; fourth, 7.6 mm.

Male from New Hampshire. Coloration as in female except for an anterior, diamond-shaped, longitudinal white mark on dorsum of abdomen. The first coxa has a hook on the distal margin, the second a spur. The second tibia is very strong with strong macrosetae. Total length, 7 mm. Carapace, 6.5 mm long, 4.6 mm wide. First femur, 6.9 mm; patella and tibia, 8.4 mm; metatarsus, 4.9 mm; tarsus, 1.7 mm. Second patella and tibia, 8.4 mm; third, 5.0 mm; fourth, 6.7 mm.

*Variation.* Individuals of this rare species differ in size and coloration. The largest specimens come from the southern United States. Females are up to 28 mm in total length; one measuring 21 mm in total length had the carapace 10.0 mm long, 8.6 mm wide. The smallest specimen comes from Canada; the smallest female measured 13 mm in total length, carapace 6.1 mm long, 5.6 mm wide. Many northern and southern specimens are strikingly colored on the abdomen (Plate 3, Fig. 22), others are just shades of brown in alcohol (Fig. 21). The scape of the epigynum is variable in length, and the median depressed area in posterior view is of variable width, narrowest in some southern specimens (Fig. 20) called *A. kisatchius* by Archer. However, intermediate epigyna are common.

*Diagnosis.* Females of *A. bicentenarius* and *A. andrewsi* differ from *A. diadematus* and *A. saevus*, both of which also have a long epigynal scape, by having the median area of the epigynum in posterior view depressed and light (Figs. 17, 20, 29).

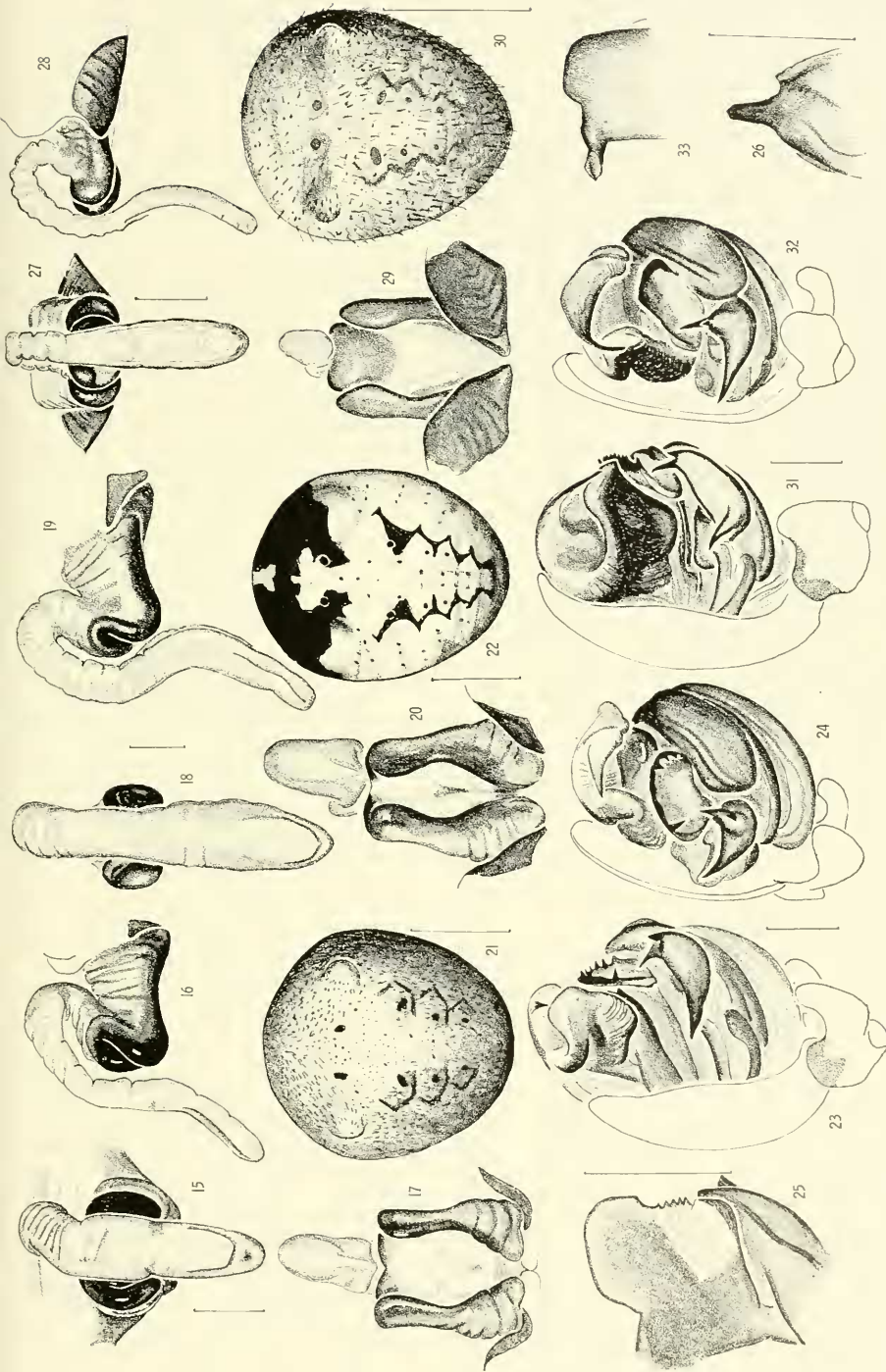
Males of *A. bicentenarius* and *A. andrewsi* differ from males of other groups by having the margin of the conductor toothed (Figs. 23, 24, 31, and easily seen in apical view) and by the shape of the embolus, the tip of which can only be seen in ventral view (Figs. 26, 33) after removal of the conductor.

The related Eurasian *A. angulatus* has the median, posterior area of the epigynum swollen and sclerotized, rather than depressed (Fig. 11), and the embolus and terminal apophysis of the palpus (Figs. 12–14) differ in shape from those of the two North American species.

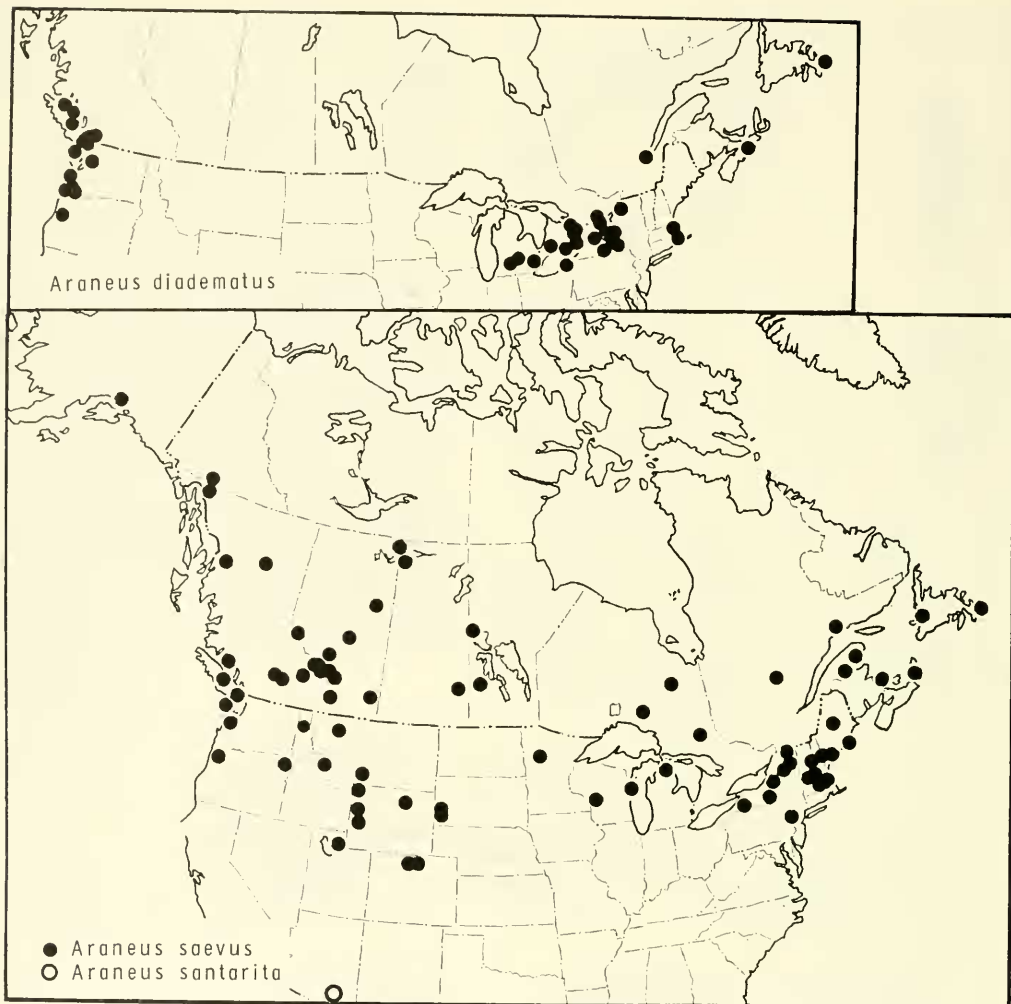
In females of the related Pacific coast *A. andrewsi*, the median posterior depressed area of the epigynum is distally (ventrally) black and swollen (Fig. 29); that of *A. bicentenarius* is not swollen and is light in color (Figs. 17, 20). Males of *A. andrewsi* have the tip of the terminal apophysis sclerotized and pointed (Figs. 31, 32), while that of *A. bicentenarius* is an acute fleshy lobe (Figs. 23, 24). The embolus can be seen under the terminal apophysis inside the palpus. The embolus differs slightly in shape in different specimens; its opening is ventral and is partly hidden by the conductor.

*Note.* In collections and literature *A. bicentenarius* has often been called *A. angulatus*, as have large specimens of various North American *Araneus* species.

*Habits.* *Araneus bicentenarius* is found on trees in woods. One brightly marked specimen was collected by a botanist among lichens on jack pine (*Pinus banksiana*). The dorsal pattern makes the spider disappear among *Evernia mesomorpha*, *Parmelia aurulenta*, and *P. caperata*. (L. L. Darrow, personal communication.) Another was green when collected, and "blended perfectly with lichens, etc." on a maple tree in West Virginia. (Plate 3) (W. A. Shear, personal communication). This last specimen was brown in alcohol and did not have contrasting markings. Most collections of this rare species consist



Figures 15-26. *Araneus bidentariarius* (McCook). 15-20. Epigynum. 15-17. (New Jersey). 18-19. (Alabama). 15, 18. Ventral. 16, 19. Lateral. 17, 20. Posterior. 21, 22. Dorsum of female abdomen. 23-26. Left palpus. 23. Mesal. 24. Ventral. 25. Embolus and conductor. 26. Embolus, ventral.  
 Figures 27-33. *A. andrewsi* (Archer). 27-29. Epigynum. 27. Ventral. 28. Lateral. 29. Posterior. 30. Female abdomen. 31-36. Palpus. 31. Mesal. 32. Ventral. 33. Embolus, ventral.  
 (Size indicators 0.5 mm, except abdomens: 5 mm)



Map. 2. Distribution of *Araneus diadematus* Clerck, *Araneus saevus* (L. Koch) and *Araneus santarita* (Archer).

of single specimens, very few of which are males.

*Distribution.* Eastern North America from Nova Scotia, Minnesota to northern Florida and Texas (Map 1); one male came from Coyote, New Mexico.

*Araneus andrewsi* (Archer)

Figures 27–33; Map 1

*Aranea andrewsi* Archer, 1951, Amer. Mus. Novitates, 1487: 31, figs. 63, 64, 82, ♀, ♂. Male holotype from Claremont, California, in the American Museum of Natural History.

*Description.* Female. Carapace brown, darker on sides. Sternum mottled brown. Legs mottled dark brown, indistinctly banded. Dorsum of abdomen brownish black, mottled, with a folium. Ventrally, area between epigynum and spinnerets dark gray. Carapace hairy. Abdomen with two large humps, very hairy, and with many very small sclerotized plates, the bases of setae. Total length, 14 mm. Carapace, 6.7 mm long, 5.9 mm wide. First femur, 6.3 mm; patella and tibia, 9.2



mm; metatarsus, 5.1 mm; tarsus, 1.8 mm. Second patella and tibia, 8.4 mm; third, 5.1 mm; fourth, 7.6 mm.

Male. Coloration like that of female; very dark and hairy. Abdomen with distinct humps. First coxa with a hook on distal margin, second with a large cone. Second tibia strong and bent, armed with macrosetae. Total length, 11 mm. Carapace, 5.2 mm long, 4.4 mm wide. First femur, 5.9 mm; patella and tibia, 8.4 mm; metatarsus, 4.6 mm; tarsus, 1.7 mm. Second patella and tibia, 7.6 mm; third, 4.2 mm; fourth, 5.9 mm.

*Variation.* Many individuals are almost black with the folium outline barely visible. Females measured 11–22 mm in total length, with carapace 5.0–7.8 mm long, 4.8–6.1 mm wide. Males measured 8–11 mm in total length; the smallest had the carapace 4.7 mm long, 3.6 mm wide.

*Diagnosis.* This Pacific coast species cannot be confused with any others in California. It differs from the related eastern North American *A. bicentenarios* in details of the genitalia (see under *A. bicentenarios*).

*Habits.* Specimens have been collected in a house basement. Another was in curled-up bark of a eucalyptus tree, with the web at chest height, strung toward a fence below the spider. Other specimens were collected on tree bark, and on the trunk of a walnut tree (*Juglans californica*).

*Distribution.* *Araneus andrewsi* is found from Oregon to southern California along the coast (Map 1).

### ***Araneus diadematus* Clerck, Cross Spider<sup>1</sup>** **Figures 34–41, 95, 184–186; Map 2**

*Araneus diadematus* Clerck, 1757, Svenska Spindlar, p. 25, pl. 1, fig. 4. The type specimens in the Natural History Museum, Stockholm, lost. Locket and Millidge, 1953, British Spiders, 2: 127, figs. 84a, 85a, 86a, 87a, ♀, ♂. Bonnet, 1955, Bibliographia Araneorum, 2: 486. Grasshoff, 1968, Abhandl. Senckenbergischen Naturforsch. Ges., 516: 1–100.

*Epeira diademata*, — Wiehle, 1927, Z. Morphol.

Ökol. Tiere, 8: 492; Nielsen, 1932, Biology of Spiders, Copenhagen, Vol. 2: 421.

*Aranea diadema*, — Wiehle, 1931, in Dahl, Die Tierwelt Deutschlands, 23: 70, figs. 103–108, ♀, ♂. Roewer, 1942, Katalog der Araneae, 1: 797. Kaston, 1948, Bull. Connecticut Geol. Natur. Hist. Surv., 70: 249, figs. 779–782, ♀, ♂.

*Description.* Female. Carapace yellow-brown, sternum dark brown, coxae light brown. Legs yellow-brown banded with darker brown. Dorsum of abdomen with white marks anteriorly in form of a cross (Fig. 37), a folium posteriorly. Venter with a median black band and a pair of white spots closer to spinnerets than to epigastric groove. Dorsum of abdomen often with two humps. Female from Massachusetts measured total length, 13 mm. Carapace, 4.6 mm long, 3.9 mm wide. First femur, 5.0 mm; patella and tibia, 6.7 mm; metatarsus, 4.5 mm; tarsus, 1.7 mm. Second patella and tibia, 5.9 mm; third, 3.5 mm; fourth, 5.5 mm.

Male. Banding of legs less distinct than in female and color generally darker. Abdomen with a distinct white cross, and folium more distinct than in female. The abdomen lacks humps. Second tibia modified by being stronger and having very strong short spines. A specimen from Massachusetts measured 8 mm in total length. Carapace, 3.8 mm long, 3.4 mm wide. First femur, 5.2 mm; patella and tibia, 7.1 mm; metatarsus, 4.7 mm; tarsus, 1.5 mm. Second patella and tibia, 5.7 mm; third, 3.4 mm; fourth, 5.2 mm.

*Variation.* Females vary 6.5–20 mm in total length, carapace 3.5–7.2 mm long, 3.2–6.1 mm wide. Total length of males, 5.7–13 mm.

The shape of the abdomen and size of humps varies. The epigynal scape may vary slightly in length and the posterior triangular sclerite (Fig. 36) varies in shape and is often much less pointed behind. There are also small differences in the embolus curvature. This species and its variation were recently studied by Grasshoff (1968).

<sup>1</sup> Garden Spider in Great Britain.

*Diagnosis.* Almost all females and many males can readily be recognized by the white marks arranged in the form of a cross on the dorsum of the abdomen (Fig. 37). No other species in North America has the cross mark. In addition, females are distinguished by the posterior face of the epigynum, which has a median triangular sclerite with the straight edge out, pointed end in (dorsally) (Fig. 36). The homologous sclerite in *A. saevus* has the outer flat edge with a median notch (Figs. 44, 47, 50) and the sclerite heart-shaped; the notch leads to a depression under the scape (Fig. 45) not present in *A. diadematus* (Fig. 34). *Araneus diadematus* has the openings usually distinctly visible in ventral view anterior of the triangular plate (Fig. 34).

Males are separated from all other *Araneus* species by the recurved embolus, triangular and pointed at its tip (Figs. 38, 40, 41), from *A. saevus* by the short, slightly curved terminal apophysis, and by the shape of the conductor (Figs. 38, 39).

*Habits.* In Europe the species is widespread and common in woods, gardens, and fields. In eastern North America, *A. diadematus* seems to do well only in cities in shrubs between houses, a habitat not to the liking of any native species of *Araneus*. In the west records are "from floor of food store," "web in woodpile," and many in cities. It may take two years for the animal to mature in Europe (Locket and Millidge, 1953). The female is more likely to remain in the center of the web at daytime than other American species. The species has been used for experimental research. The web has about 30 spokes and is made at up to 1.5 m height. The web has been illustrated by Wiehle, 1927, and Nielsen, 1932; the egg sac by Nielsen.

*Distribution.* This Eurasian species appears introduced, judging by its limited distribution in North America and its preferred habitat of shrubs surrounding city houses. It survives only in a narrow belt from Newfoundland south to Rhode Island,

west to Vancouver and Oregon, more abundant on the milder coasts than in the Great Plains and mountain states (Map 2). Samples of records are St. Johns, Newfoundland; Quebec; Toronto; Vancouver; Victoria; Boston; Newport, Rhode Island; Syracuse; Ithaca; Rochester; Detroit; East Lansing; Seattle; Portland, and some smaller towns. The oldest American collections are about 100 years old and come from the northeast. The species does occur in Siberia and Japan. Specimens from the USSR, 64 km SSW of Irkutsk on Lake Baikal, were examined; they differed more from European ones than do North American specimens, presumably due to geographic variation.

#### *Araneus saevus* (L. Koch)

##### Figures 7–8, 42–51, 55–60; Map 2

*Epeira saeva* L. Koch, 1872, Z. Ferdinandeum Tirol Vorarlberg, (3) 17: 323. Male holotype specimens from Bad Ratzes, Austria [above Siusi, Trentino Alto Adige, Italy], in the British Museum, Natural History, examined.

*Epeira solitaria* Emerton, 1884, Trans. Connecticut Acad. Sci., 9(6): 299, pl. 33, fig. 11, pl. 35, fig. 3, ♂. Male holotype from Peabody, Massachusetts, in the Museum of Comparative Zoology, examined.

*Epeira silvatica*. — Emerton, 1884, Trans. Connecticut Acad. Sci., 9(6): 300 (in part), pl. 35, figs. 1–6, ♀. Female paralectotype here designated, not lectotype.

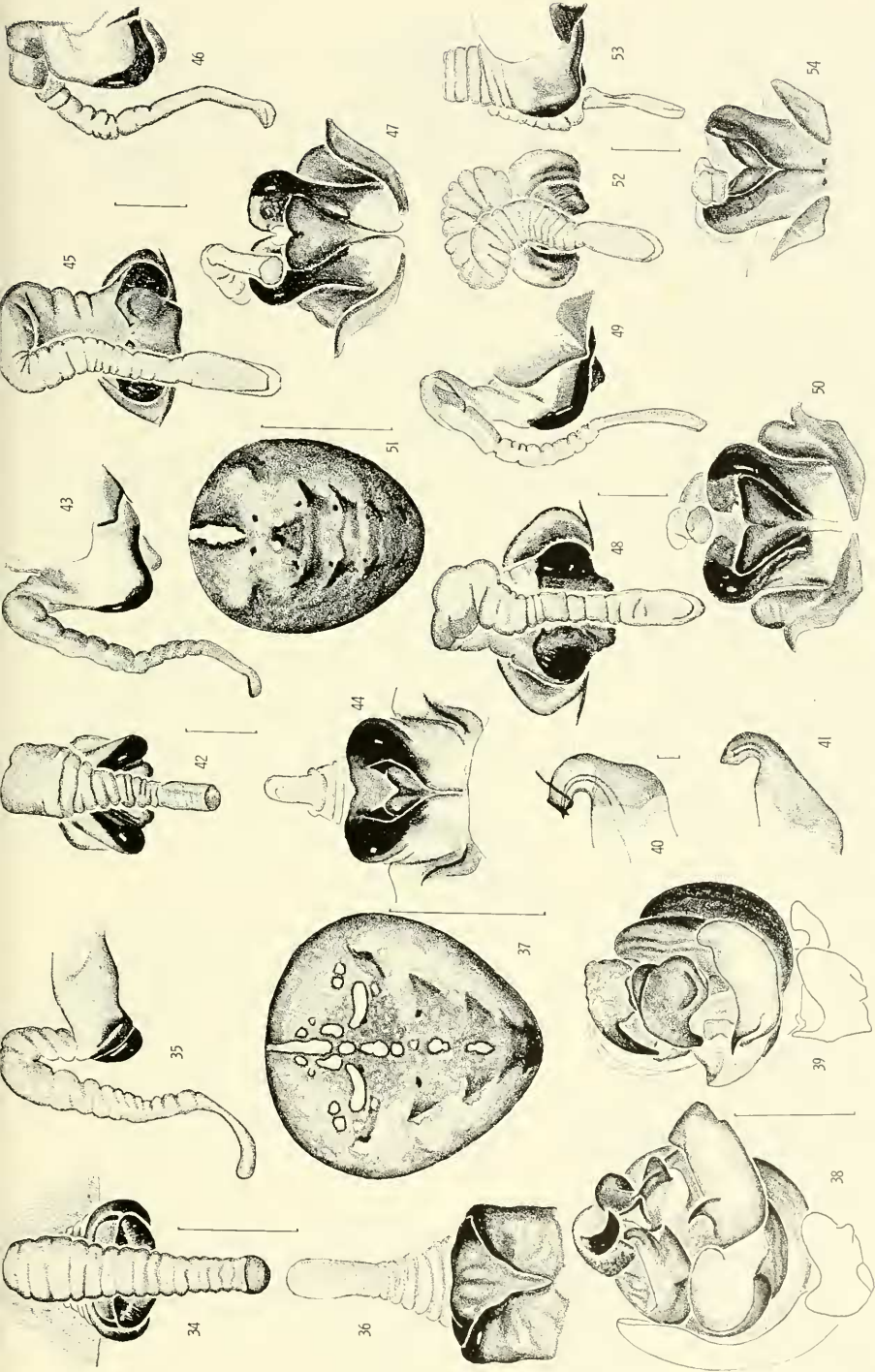
*Epeira nigra* Emerton, 1894, Trans. Connecticut Acad. Sci., 14(3): 402, pl. 1, fig. 1, ♀, ♂. Male and female syntypes from Laggan, Canada ["5000–8500' in Rocky Mountains near Canadian Pacific Railway" a station near present-day Lake Louise], in the Museum of Comparative Zoology, examined.

*Aranea saeva*. — Roewer, 1942, Katalog der Araneae, 1: 791.

*Aranea solitaria*. — Roewer, 1942, Katalog der Araneae, 1: 863. Kaston, 1948, Bull. Connecticut Geol. Natur. Hist. Surv., 70: 250, figs. 785–786, 796–797, ♀, ♂.

*Araneus saevus*. — Tullgren, 1952, Entomol. Tidskr., 73: 164, figs. 10, 12, ♀, ♂. Bonnet, 1955, Bibliographia Araneorum, 2: 588. Wiehle, 1963, Zool. Jahrb. Abt. System., 90: 276, figs. 84–92, ♀, ♂.

*Description.* Female from near Lake Louise, Alberta. Carapace, sternum and



Figures 34-41. *Araneus diadematus* Clerck. 34-36. Epigynum. 34. Ventral. 35. Lateral. 36. Posterior. 37. Female abdomen. 38-41. Left palpus. 38. Mesal. 39. Ventral. 40, 41. Embolus. 40. With cap. 41. Without cap.  
 Figures 42-51. *A. saevus* (L. Koch). 42-50. Epigyna. 42-44. (Colorado). 45-50. (New York). 42, 45, 48. Ventral. 43, 46, 49. Lateral. 44, 47, 50. Posterior. 51. Female abdomen.  
 Figures 52-54. *A. santarita* (Archer) epigynum. 52. Ventral. 53. Lateral. 54. Posterior.  
 (Size indicators 0.5 mm, embolus tips 0.05 mm, and abdomens 5 mm)

legs dark brown to black with some silvery hair. Abdomen dark brown with a darker folium, usually with a white anterior longitudinal cardiac mark and two ventral white spots side by side. Abdomen covered with long and short hair. Total length, 13 mm. Carapace, 5.4 mm long, 4.6 mm wide. First femur, 5.3 mm; patella and tibia, 7.1 mm; metatarsus, 4.2 mm; tarsus, 1.7 mm. Second patella and tibia, 6.4 mm; third, 4.2 mm; fourth, 6.5 mm.

Male from same locality. Male a little darker than female. First coxa with a hook on distal margin, the second with a spur. Second tibia swollen and with macrosetae. Total length, 9 mm. Carapace, 5.0 mm long, 4.0 mm wide. First femur, 5.0 mm; patella and tibia, 6.3 mm; metatarsus, 3.5 mm; tarsus, 1.4 mm. Second patella and tibia, 6.1 mm; third, 3.8 mm; fourth, 5.4 mm.

*Variation.* Although the abdomen is usually black with an anterior white cardiac mark (Fig. 51), at times the color is brown, but the white mark may persist. Females varied in total length 11–17 mm, carapace, 4.0–6.0 mm long, 3.2–5.2 mm wide; males were 9–11 mm in total length, carapace, 5.0–5.2 mm long, 4.0–4.5 mm wide.

*Diagnosis.* Although many specimens in collections were misidentified, females can be confused only with *A. diadematus*. The abdomen of *A. saevus* does not have the spots arranged in the cross typical of *A. diadematus* and the epigynum differs in details (see *A. diadematus*).

The male may be confused with *A. nordmanni*, but unlike *nordmanni* the terminal apophysis, a black prong, is very strongly curved (Figs. 7, 8, 55, 56).

*Habits.* *Araneus saevus* is found in forests on trees; it has been found on lodgepole pine (*Pinus contorta*) in the Canadian Rockies, and on a poplar tree (*Populus* sp.) in Maine.

*Distribution.* Comparison of specimens confirmed Wiehle's recent observation (Wiehle, 1963) that *A. solitarius* of North

America is the same as the Eurasian *A. saevus*. The species is found in America probably from southern Alaska south to New York state and Oregon (Map 2).

### *Araneus santarita* (Archer)

#### Figures 52–54; Map 2

*Aranea santarita* Archer, 1951, Amer. Mus. Novitates, 1587: 24, fig. 65, ♀. Female holotype from Santa Rita Mtns., Arizona, in the American Museum of Natural History, examined.

*Description.* Female holotype. Head area dark brown; posterior and sides of carapace lighter. Sternum brown with white median longitudinal band. Legs brown with bands barely showing. The damaged abdomen is slightly reddish in color, and has small humps. Total length, 17 mm. Carapace, 6.0 mm long, 5.9 mm wide. First femur, 8.6 mm; patella and tibia, 10.0 mm; metatarsus, 6.7 mm; tarsus, 2.4 mm. Second patella and tibia, 9.6 mm; third, 6.0 mm; fourth, 8.8 mm.

*Diagnosis.* This may be an atypical specimen of *A. saevus*. It differs by its more twisted epigynal scape (Fig. 52) and details in posterior aspect of the epigynum (Fig. 54).

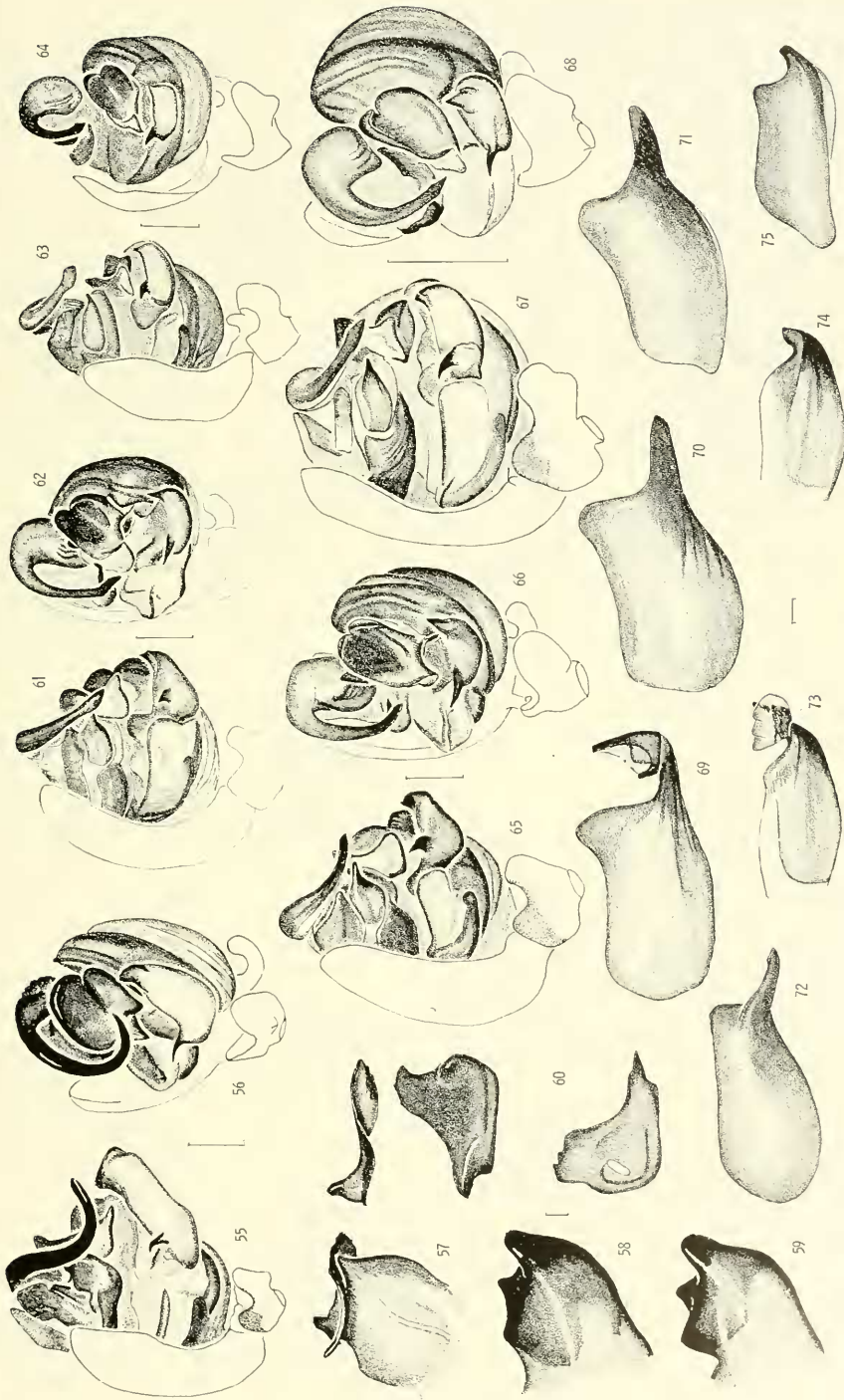
*Distribution.* This species is known only from the type specimen from Arizona (Map 2).

### *Araneus nordmanni* (Thorell)

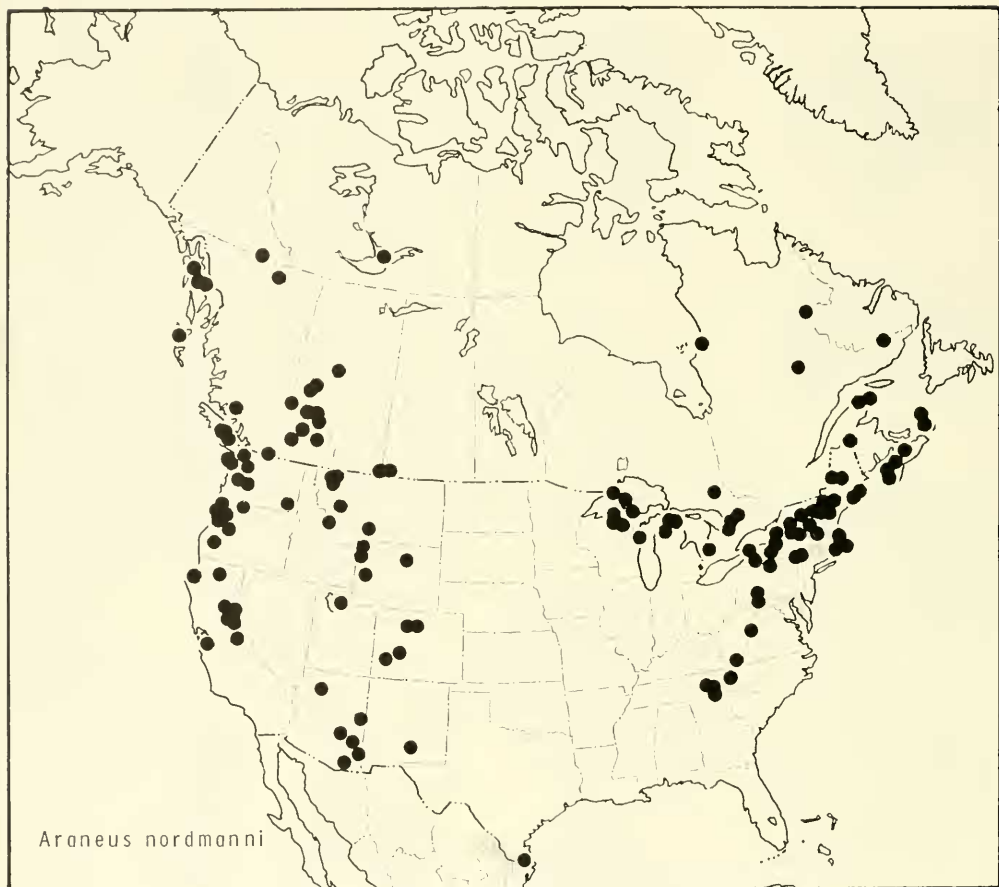
#### Figures 61–94, 96–99; Map 3

*Epeira nordmanni* Thorell, 1870, Remarks on Synonyms of European Spiders, p. 4. Holotype from Uppland, Sweden [area north of Stockholm including Uppsala]. The type was destroyed when the Swedish freighter "Oklahoma" carrying it in the mail sank off Great Britain in December 1953. Thorell, 1873, Remarks on Synonyms of European Spiders, p. 544. Emerton, 1885, Trans. Connecticut Acad. Sci., 6: 301, pl. 33, fig. 6, ♀; Emerton, 1894, Trans. Connecticut Acad. Sci., 9: 403, pl. 1, fig. 2, ♀, ♂. Nielsen, 1932, The Biology of Spiders, Copenhagen, Vol. 1, fig. 38.

*Epeira silvatica* Emerton, 1884, Trans. Connecticut Acad. Sci., 6: 300, pl. 33, fig. 13, pl. 35, figs. 1, 4, ♂. Male lectotype from Beverly, Massachusetts, in the Museum of Comparative Zoology, here designated, examined.



Figures 55-60. *Araneus saevus* (L. Koch), left palpus. 55. Mesal. 56. Ventral. 57-60. Embolus. 57. With cap. 58, 59. Without cap. 60. Different aspects of a cap.  
 Figures 61-75. *A. nordmanni* (Thorell), palpus. 61, 62. (Colorado). 63, 64. (Massachusetts). 65, 66. (Arizona). 67, 68. (Montana). 61, 63, 65, 67. Mesal. 62, 64, 66, 68. Ventral. 69-75. Embolus. 69, 70. (Colorado). 71. (Arizona). 72. (New Mexico). 73, 74. (Montana). 75. (Massachusetts). 69, 73. With cap.  
 (Size indicators 0.5 mm, embolus tips 0.05 mm)



Map 3. Distribution of *Araneus nordmanni* (Thorell).

*Aranea nordmanni*, — Wiehle, 1931, in Dahl, Tierwelt Deutschlands, 23: 58, figs. 84, 85, ♀. Roewer, 1942, Katalog der Araneae, 1: 801. Kaston, 1948, Bull. Connecticut Geol. Natur. Hist. Surv., 70: 250, figs. 783-784, 793-795, ♀, ♂.

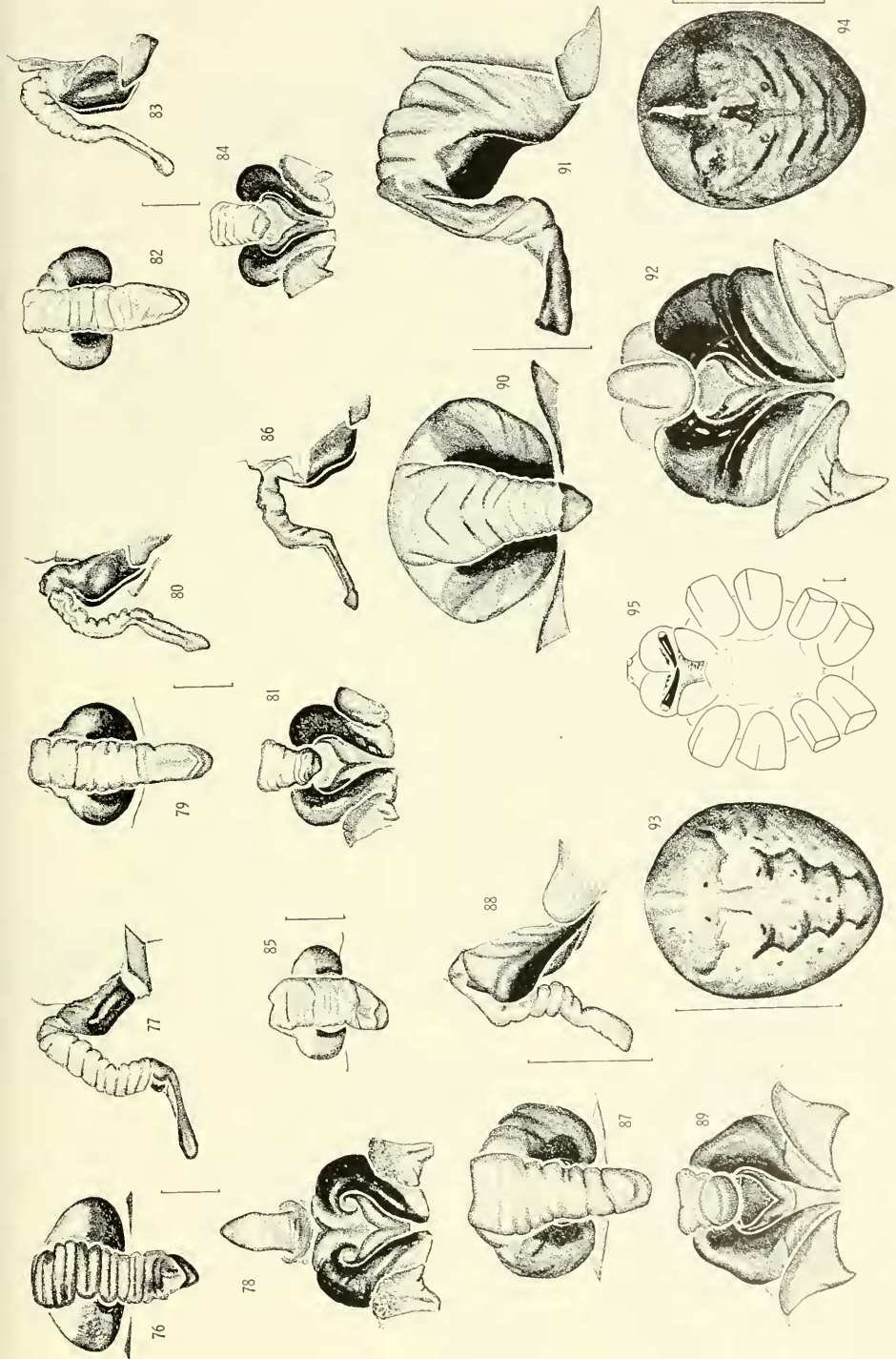
*Aranea darlingtoni* Archer, 1951, Amer. Mus. Novitates, 1487: 25, figs. 71, 75, ♀, ♂. Female holotype from Durbin, West Virginia, in the American Museum of Natural History; paratypes examined. NEW SYNONYMY.

*Aranea pseudomelacna* Archer, 1951, Amer. Mus. Novitates, 1487: 26, figs. 70, 79, ♀, ♂. Male holotype from Long's Peak, Colorado, in the American Museum of Natural History, examined. NEW SYNONYMY.

*Araneus nordmanni*, — Bonnet, 1955, Bibliographia Araneorum, 2: 553. Wiehle, 1963, Zool. Jahrb. Abt. System., 90: 271, figs. 74-83, ♀, ♂.

*Note.* Archer named American specimens *A. darlingtoni* because he thought that European ones lack the basal spur on coxa II. Wiehle (1963) illustrated the spur, and all European males examined had it. Also Archer indicates that "on the endal side [of the median apophysis] below the spur is a rounded angle, a feature entirely missing in *A. nordmanni*." As discussed in the introduction, the median apophysis by itself is not a good character to separate species.

*Araneus pseudomelaena* Archer was thought to be a valid entity, but extremely variable. As more collections were examined it was found that those specimens



Figures 76-94. *Araneus nordmanni* (Thorell). 76-92. Epigynum. 76-78. (Arizona). 79-81. (Texas). 82-84. (Oregon). 85-86. (Brit. Columbia). 87-89. (Montana). 90-92. (North Carolina). 76, 79, 82, 87, 90. Ventral. 77, 80, 83, 86, 88, 91. Lateral. 78, 81, 84, 89, 92. Posterior. 93, 94. Female abdomen. 93. (Montana). 94. (Texas).  
 Figure 95. *A. diadematus* Clerck, female, venter of cephalothorax.  
 (Size indicators 0.5 mm, abdomens 5 mm)

ascribed to *pseudomelaena* were all allopatric with *A. nordmanni*, and also that many specimens had to be arbitrarily placed in one or the other. The problem of *A. pseudomelaena* is discussed in greater detail in the introduction and in the paragraph on variation below.

*Description.* A female specimen from Montana had carapace light brown, sternum dark brown, coxae and femora light brown, distal segments of legs banded, dorsum of abdomen with a distinct folium (Fig. 93), venter with a dark brown band between epigynum and spinnerets, on each side of which is a white bracket. Dorsum of abdomen with two humps. Total length, 8.5 mm. Carapace, 3.2 mm long, 2.5 mm wide. First femur, 3.4 mm; patella and tibia, 4.3 mm; metatarsus, 2.8 mm; tarsus, 1.2 mm. Second patella and tibia, 3.8 mm; third, 2.4 mm; fourth, 3.5 mm.

A female from Arizona had the carapace rich dark brown, sternum dark brown, and legs dark brown. Only edges of labium and of endites light. Abdomen brown to black. Venter with two white spots side by side. Sometimes a white longitudinal mark between two humps (Fig. 94) on abdomen. Total length, 15 mm. Carapace, 6.5 mm long, 5.6 mm wide. First femur, 6.8 mm; patella and tibia, 8.5 mm; metatarsus, 5.5 mm; tarsus, 1.7 mm. Second patella and tibia, 8.4 mm; third, 5.4 mm; fourth, 8.0 mm.

Male. A specimen from Montana had coloration as in female. Venter with a black band and two white brackets, or brackets often reduced to four white spots. The abdomen is longer than wide and much wider in front than behind. The humps are small. The first coxa has a distal hook, the second a spur. The second tibia is bent and bears strong macrosetae. Total length, 7.5 mm. Carapace, 4.2 mm long, 3.2 wide. First femur, 4.6 mm; patella and tibia, 5.8 mm; metatarsus, 3.4 mm; tarsus, 1.2 mm. Second patella and tibia, 4.7 mm; third, 3.0 mm; fourth, 4.6 mm.

A male from Graham Mountains, Arizona, had coloration like that of female from Arizona. Distal segments of legs lighter and banded. Abdomen almost black with two humps. First coxa with a hook on distal margin, second with a spur. Second tibia modified with spines and swollen. Total length, 10 mm. Carapace, 6.4 mm long, 5.5 mm wide. First femur, 7.5 mm; patella and tibia, 9.2 mm; metatarsus, 5.7 mm; tarsus, 1.7 mm. Second patella and tibia, 8.0 mm; third, 5.0 mm; fourth, 7.6 mm.

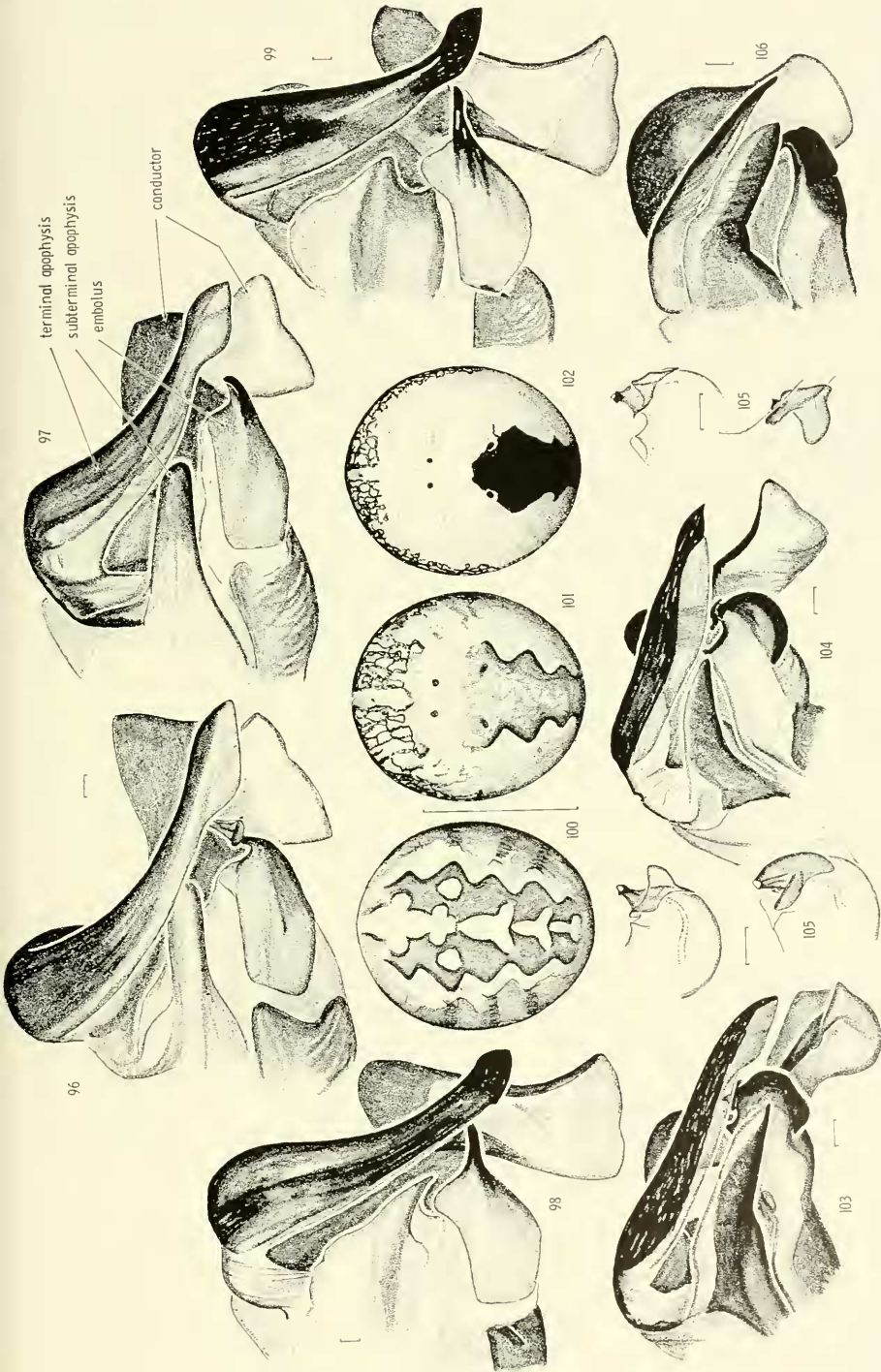
*Variation.* The size and coloration of this species are variable. The largest and darkest specimens are found in the southwestern part of the range; the size given above is for the largest. The total length of females is 7–19 mm, the smallest having the carapace 3.0 mm long, 2.8 mm wide. Males range 6–10 mm, the smallest having the carapace 3.1 mm long, 2.8 mm wide.

Often specimens in alcohol are strikingly colored black and white, the legs contrastingly banded.

The genitalia of *A. nordmanni* become increasingly variable as one moves south, especially the structures of the male palpus, including the median apophysis so carefully studied by Archer (Figs. 61–68). But no two males in the southern part of the range have the median apophysis or the embolus identical (Figs. 69–75, 96–99), and as these variable southern populations are allopatric with the less variable northern *A. nordmanni*, and many males would have to be arbitrarily placed, they are considered one species. Except for epigynum size and scape length and shape, the epigyna are all alike.

*Diagnosis.* In the part of the range in which *A. nordmanni* overlaps with *A. saevus*, the former is smaller than the latter species; outside the range of *A. saevus* it is larger. Females of *A. nordmanni* have a much shorter scape (Figs. 87, 90) than those of *A. saevus*. The species can be confused with the sympatric *A. cavaticus*





Figures 96-99. *Araneus nordmanni* (Thorell), terminal apophysis and embolus of left male palpus, mesal. 96. (Tennessee). 97. (Montana). 98, 99. (California).

Figures 100-105. *A. marmoreus* Clerck. 100-102. Female abdomen. 103, 104. Terminal apophysis and embolus of palpus, mesal. 103. (Saskatchewan). 104. (Nova Scotia). 105. Embolus cap of a male which has just molted.

Figure 106. *A. washingtoni* sp. n., terminal apophysis and embolus of palpus, mesal. (Size indicators 0.05 mm for palpal parts, about 5 mm for abdomens)

in the eastern part of Canada and United States; however, in posterior view of *A. nordmanni* the rims of the epigynum enclose a semicircular, heart-shaped depression (Figs. 89, 92) that is absent in *A. cavaticus* (Fig. 189). *A. nordmanni* females have humps on the abdomen, distinguishing them from females of *A. manitobae*, which have a somewhat similar epigynum.

The prong of the terminal apophysis of the male palp (Figs. 96–99) is less sclerotized and less strongly curved in *A. nordmanni* than in *A. saevus*. The shape of the embolus, which opens on a tip pointing away from the cymbium, is quite characteristic (Figs. 69–75) and distinguishes all male specimens of *A. nordmanni* from all other North American *Araneus* species.

*Habits.* *Araneus nordmanni* is found on trees or, sometimes, boulders, often in dark coniferous forests, and often at high elevations in mountains (for instance, Mt. Grizzly, Brit. Col., at 1600–2200 m elevation and Long's Peak in Colorado). Collection comments read: On lodgepole pine (*Pinus contorta*) in Alberta; on bush in Montana; on birch (*Betula* sp.) on Mt. Katahdin, Maine; on building in Porcupine Mts., Michigan; mixed ponderosa pine (*Pinus ponderosa*) and juniper (*Juniperus* sp.) in Springerville, Arizona. Nielsen (1932) shows a retreat among lichens on branches.

*Distribution.* *Araneus nordmanni* was first described from Scandinavia. It has since only rarely been found in Europe. I have examined specimens from Adelboden, Switzerland; Giant Mountains, now eastern Poland; Upland, Sweden; and Järve, Finland. All are much alike and much like specimens from the northern parts of North America. A new record from 64 km SSW of Irkutsk, on Lake Baikal, Siberia, USSR, 13. VIII. 1968 (B. and J. Hocking), indicates that this species does have a wide distribution in Eurasia. In North America it seems to occur in forested regions north of Mexico (Map 3).

***Araneus marmoreus* Clerck, Marbled Spider**  
**Figures 1–6, 100–105, 107–113, 183;**  
**Map 4**

*Araneus marmoreus* Clerck, 1757, Svenska Spindlar, p. 29, pl. 1, fig. 2, ♀. Female type from Sweden in the Natural History Museum, Stockholm, lost. Lockett and Millidge, 1953, British Spiders, 2: 130, figs. 79d, 84c, 85e, 86e, 87b, ♀, ♂. Bonnet, 1955, Bibliographia Araneorum, 2: 534. Grasshoff, M., 1968, Abhandl. Senckenbergischen Naturforsch. Ges., 516: 1–100.

*Aranea raji* Scopoli, 1763, Entomologia Carniolica, p. 394. The Scopoli collection was destroyed in the 18th century (Horn and Kahle, 1936, Entomol. Beihefte, 3: 252). Wiehle, 1931, in Dahl, Die Tierwelt Deutschlands, 23, p. 75, figs. 109–114, ♀, ♂. Roewer, 1942, Katalog der Araneae, 1: 802.

*Epeira insularis* Hentz, 1847, Boston J. Natur. Hist. Soc., 5: 470, pl. 30, fig. 10, ♀. Female holotype from an island in the Tennessee River, destroyed. Emerton, 1884, Trans. Connecticut Acad. Sci., 6: 309, pl. 33, fig. 1, pl. 35, fig. 18, ♀, ♂. Keyserling, 1892, Die Spinnen Amerikas, 4: 170, pl. 8, fig. 126, ♀.

*Epeira obesa* Hentz, 1847, Boston J. Natur. Hist. Soc., 5: 471, pl. 30, fig. 11, ♀. Female holotype from Maine, destroyed.

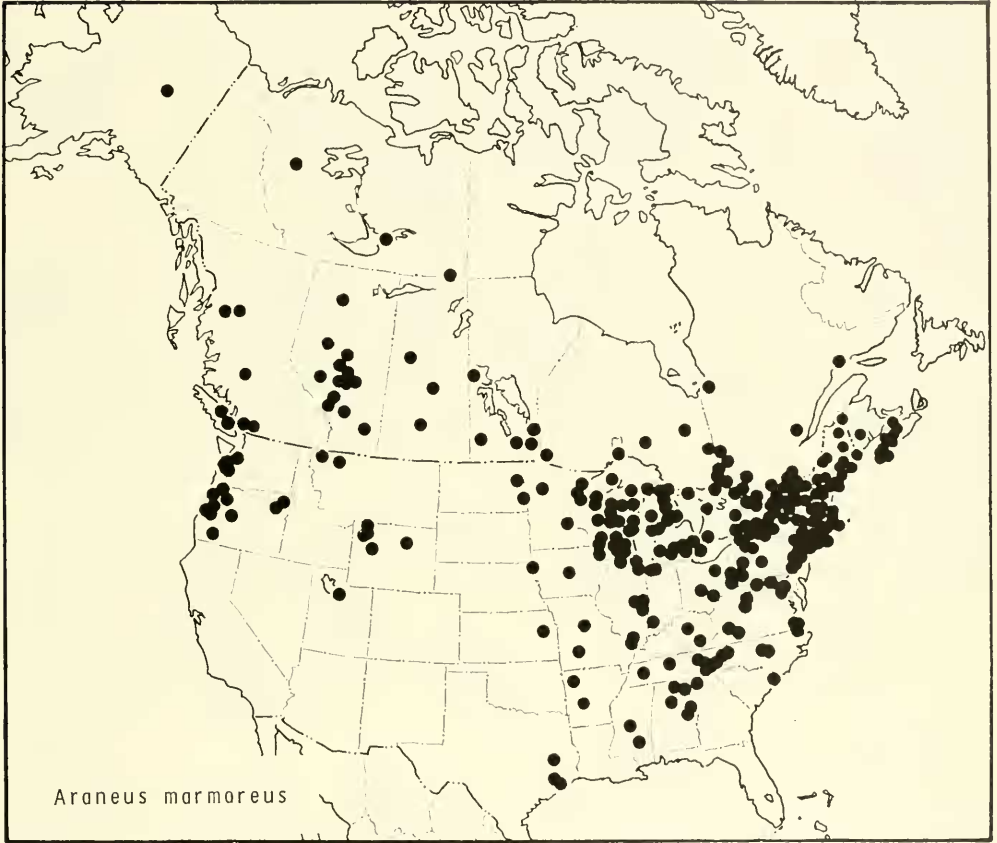
*Epeira marmorea*. — Emerton, 1884, Trans. Connecticut Acad. Sci., 6: 307, pl. 33, fig. 2, pl. 35, fig. 17, ♀, ♂.

*Aranea gigas*. — Comstock, 1912, The Spider Book, p. 475, figs. 493–498, ♀, ♂; 1940, The Spider Book, rev. ed., p. 489, figs. 493–498, ♀, ♂. Not *A. gigas* Leach; not *A. gigas* C. L. Koch.

*Aranea tusigia* Chamberlin, 1919, Ann. Entomol. Soc. Amer., 12: 254, pl. 19, fig. 3, ♂. Male holotype from Chalk Creek, Utah, in the Museum of Comparative Zoology, examined. NEW SYNONYMY.

*Epeira raji*. — Kaston, 1948, Bull. Connecticut Geol. Natur. Hist. Surv., 70: 257, figs. 816–822, 2048–2049.

*Description.* Female from Michigan. Carapace light brown, sternum dark brown, legs light brown, indistinctly banded. Abdomen with dorsum white to yellow or orange, having a dark pattern of grays and blacks, with black lines around light spots. Venter with a black band enclosed by white brackets. Total length, 14 mm. Carapace, 5.2 mm long, 4.5 mm wide. First femur, 5.4 mm; patella and tibia, 6.7 mm; metatarsus, 4.0 mm; tarsus, 1.6 mm. Second



Map 4. Distribution of *Araneus marmoreus* Clerck.

patella and tibia, 6.4 mm; third, 4.0 mm; fourth, 6.0 mm.

Male from Michigan. Coloration like that of female with legs more distinctly banded. The first coxa has a hook on the distal ventral rim, the second coxa a spur. The second tibia is swollen and bears macrosetae. Total length of a specimen from Michigan, 8.4 mm. Carapace, 5.0 mm long, 3.7 mm wide. First femur, 5.0 mm; patella and tibia, 6.7 mm; metatarsus, 3.6 mm; tarsus, 1.2 mm. Second patella and tibia, 5.9 mm; third, 3.5 mm; fourth, 5.0 mm.

*Variation.* Total length of females, 9–18 mm; carapace 2.7–5.2 mm long, 2.3–4.5 mm wide. Total length of males, 5.9 mm;

Carapace 2.9–4.3 mm long, 2.3–3.6 mm wide.

There is considerable variation in color and pattern. One female from Texas had black bands on its legs. The abdomen has a black folium in many females collected in Alberta, Montana, Wyoming, Europe, and isolated other places (Figs. 101, 102); in females from other areas the folium encloses symmetrical light patches (Fig. 100), or sometimes it has a reticulated pattern. The shape of the terminal apophysis and the length of the subterminal apophysis vary from specimen to specimen (Figs. 103, 104). Although the median apophysis of *A. marmoreus* is just as variable as that of other *Araneus* species (Grasshoff, 1968,

figs. 36e-h). *A. marmoreus* has escaped being split into several species.

**Diagnosis.** The common *A. marmoreus* differs from related *A. corticarius* and most other North American *Araneus* species by having an oval, subspherical abdomen. The female can be recognized by the large basal lamellae of the epigynum which almost always extend on each side beyond the base and are visible in ventral view (Figs. 1-3, 107-109). They also extend at times in *A. iviei*.

Males, despite the distinct palpus, are often misidentified. The terminal apophysis is sclerotized and along its proximal side is a translucent edge. The terminal apophysis is paralleled by a subterminal apophysis (Figs. 4, 6, 103, 104, 110). In *A. nordmanni* and *A. saevus* the subterminal apophysis is shorter. The embolus resembles that of *A. corticarius*, being semi-circular below the tip. The embolus lamella, if it shows at all, is in the shape of a flat hook (Figs. 4-6, 111), not a piece with parallel sides as in *A. trifolium* (Fig. 179). The conductor (Figs. 5, 111) is much wider than that of *A. trifolium* (Fig. 179) and has a clearly set off, narrower tongue facing the median apophysis.

**Habits.** *Araneus marmoreus* prefers tall meadows, and places its webs in grasses or low shrubs, sometimes on trees. In the West it has been collected in light lodgepole pine (*Pinus contorta*) forest, its retreat under bark, in a relatively humid place. Kaston (1948) reports the egg sac to be "13 mm in diameter, a flattened sphere of loose white silk. There were 653 orange, agglutinated eggs, each about 1.15 mm in diameter." The web has been illustrated by Comstock (1912, 1940) and Kaston (1948), the egg sac by Comstock. The web has 24-29 spokes and is made 50-90 cm high in grass.

**Distribution.** *Araneus marmoreus* is holarctic in distribution. The borders of its Eurasian distribution have not been critically mapped. The many literature citations of misidentified specimens will give a

mistaken idea of the distribution. In North America *A. marmoreus* is found from Alaska to the southern United States (Map 4).

### *Araneus corticarius* (Emerton)

Figures 114-122; Map 5

*Epeira corticaria* Emerton, 1884, Trans. Connecticut Acad. Sci., 6: 300, pl. 33, fig. 14, pl. 35, fig. 9, ♀. Two female syntypes from Beverly, Mass., in the Museum of Comparative Zoology, examined. McCook, 1893, American Spiders, p. 176, pl. 8, fig. 7, ♀. Emerton, 1909, Trans. Connecticut Acad. Sci., 14: 199, pl. 5, fig. 3, ♂.

*Epeira incestifica* Keyserling, 1892, Die Spinnen Amerikas, 4: 132, pl. 7, fig. 98. Female holotype from Sitka, Alaska [?] (G. Marx), in the U. S. National Museum, examined.

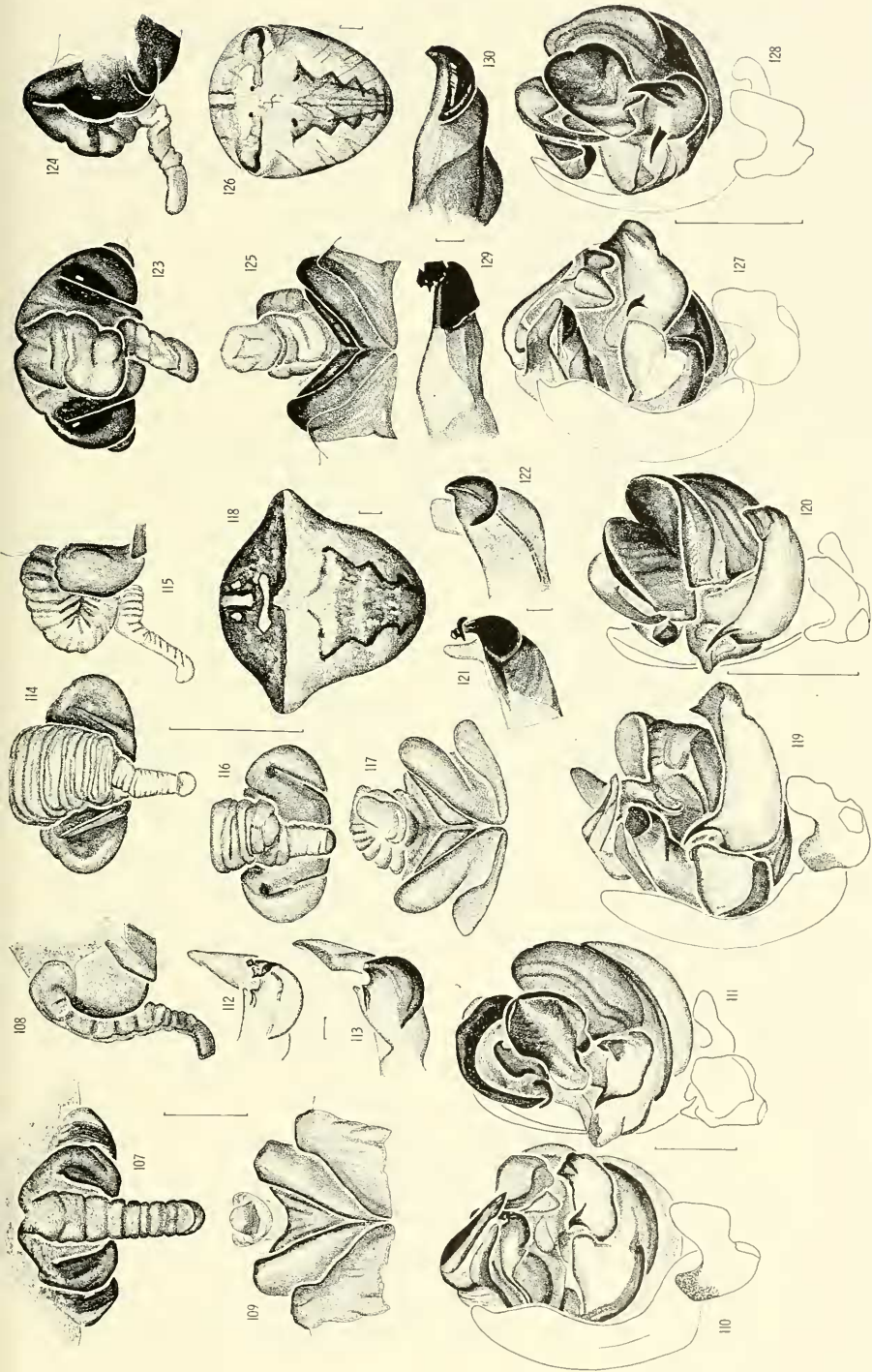
*Aranea corticaria*, — Roewer, 1942, Katalog der Araneae, 1: 860. Kaston, 1948, Bull. Connecticut State Geol. Natur. Hist. Surv., 70: 252, figs. 800-802, ♀, ♂.

*Aranea demingi* Archer, 1951, Amer. Mus. Novitates, 1487: 30, fig. 81, ♂. Male holotype from The Pas, Manitoba, in the American Museum of Natural History, examined. NEW SYNONYMY.

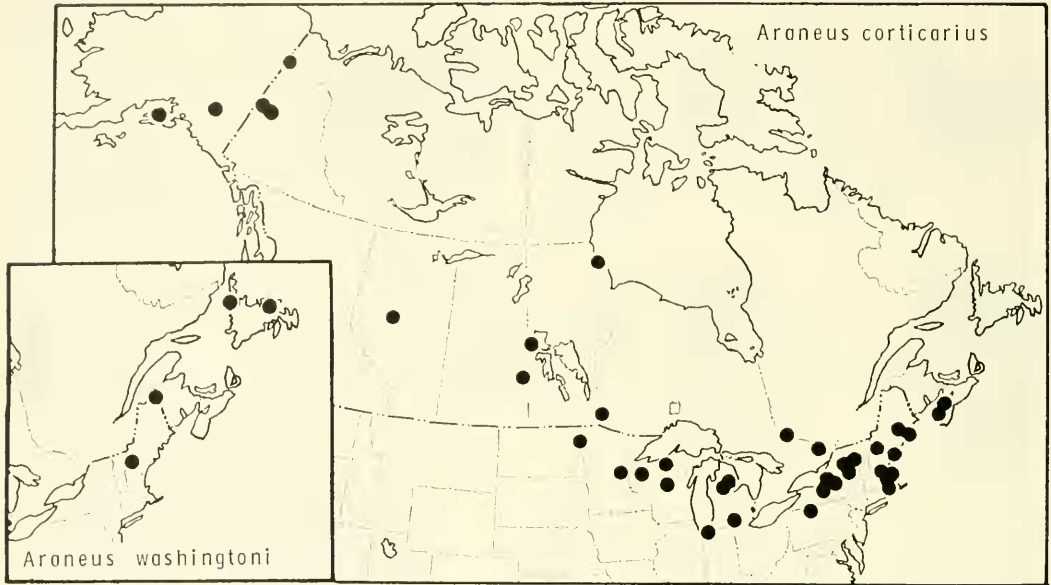
*Araneus corticarius*, — Bonnet, 1955, Bibliographia Araneorum, 2: 470.

**Description.** Female from Maine. Carapace brown with some hairs and some irregular marks. Sternum dark brown. Coxae light. Legs light, contrastingly banded. Anterior of dorsum of abdomen black with a white cross (Fig. 118). Venter black with a white bracket on each side. Abdomen with large humps. Eyes large and close together. Epigynum with a folded scape (Figs. 114, 116). Total length, 6 mm. Carapace, 2.1 mm long, 1.9 mm wide. First femur, 2.5 mm; patella and tibia, 3.0 mm; metatarsus, 1.6 mm; tarsus, 0.8 mm. Second patella and tibia, 2.7 mm; third, 1.6 mm; fourth, 2.4 mm.

Male from Maine. Less contrastingly colored than female. Abdomen marked like that of female but with less contrast. Abdomen has humps laterally. First coxa with hook, second without spur. The second tibia is swollen. Total length, 4.7 mm. Carapace 2.5 mm long, 1.8 mm wide. First femur, 3.0 mm; patella and tibia, 3.5 mm;



Figures 107-113. *Araneus marmoratus* Clerck. 107-109. Epigynum. 107. Ventral. 108. Lateral. 109. Posterior. 110-113. Left male palpus. 110. Mesal. 111. Ventral. 112, 113. Embolus. 112. With cap. 113. Without cap.  
 Figures 114-122. *A. cartficarius* (Emerton). 114-117. Epigynum. 114, 116. Ventral. 115. Lateral. 117. Posterior. 118. Female abdomen. 119-122. Male palpus. 119. Mesal. 120. Ventral. 121, 122. Embolus. 121. With cap. 122. Without cap.  
 Figures 123-130. *A. washingtoni* sp. n. 123-125. Epigynum. 123. Ventral. 124. Lateral. 125. Posterior. 126. Female abdomen. 127-130. Male palpus. 127. Mesal. 128. Ventral. 129, 130. Embolus. 129. With cap. 130. Without cap.  
 (Size indicators 0.5 mm, for palpal parts 0.05 mm)



Map 5. Distribution of *Araneus corticarius* (Emerton) and *Araneus washingtoni* sp. n.

metatarsus, 1.8 mm; tarsus, 0.8 mm. Second patella and tibia, 3.0 mm; third, 1.8 mm; fourth, 2.5 mm.

**Variation.** Total length of females varied between 5.2–8.0 mm, the carapace 2.1–2.9 mm long and 1.9–2.3 mm wide. Total length of males, 4.2–5.2 mm. The shape of the abdomen is variable.

**Diagnosis.** The shape of the abdomen, with the humps projecting toward the sides, is not seen in any other large North American *Araneus* including *A. washingtoni*. The epigynum of the female (Figs. 114–117) resembles that of *A. marmoreus*, but the epigynal lamellae are smaller, only rarely visible in ventral view, and the median field behind the scape between the rims is wider than in *A. marmoreus*. The scape usually breaks off during mating.

The embolus shape (Figs. 119, 121, 122) resembles that of *A. marmoreus*, but the enormous conductor, its length half that of the bulb in ventral view (Fig. 120), and the longer median apophysis (Figs. 119, 120) separate the species from *A. marmoreus* and *A. washingtoni*.

**Habits.** Kaston (1948) reports having collected *A. corticarius* in moist meadows and woods. It has been collected from a cranberry bog in Massachusetts, from a swamp in Wisconsin, swept from a hemlock seedling (*Tsuga canadensis*) in a swamp in Pennsylvania.

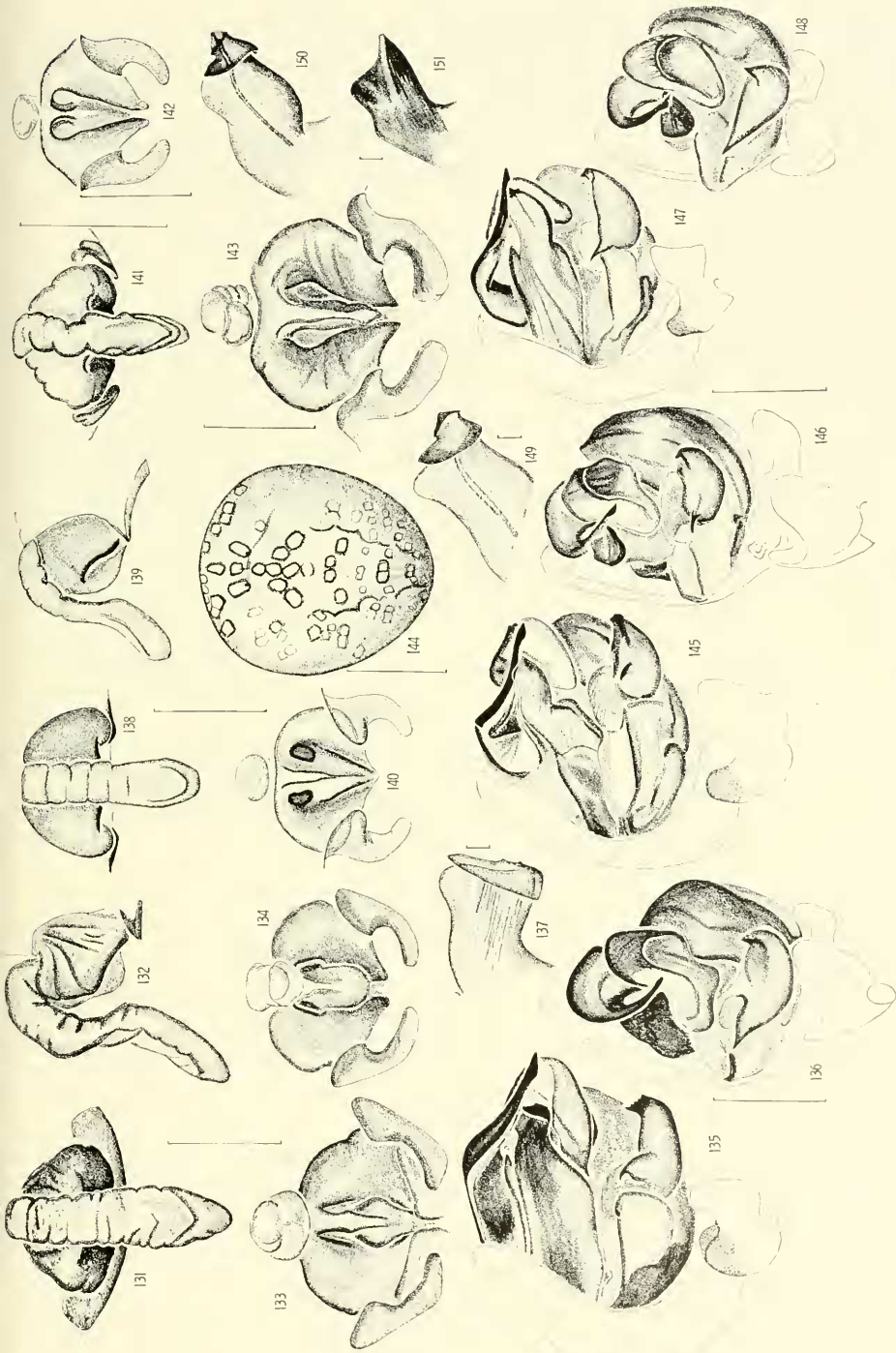
**Distribution.** *Araneus corticarius* is found from Alaska to New England. Its known range matches the range of black spruce (*Picea mariana*) and tamarack (*Larix laricina*), both bog inhabitants. The southernmost records are Ice Mine, Potter Co., Pennsylvania, and Beverly Shores, Porter Co., Indiana; the northernmost, Rampart House, Yukon Terr. (Map 5).

#### *Araneus washingtoni* sp. n.

Figures 123–130; Map 5

**Holotype.** Male from 3 miles up road, Mt. Washington [no date] (J. H. Emerton), in the Museum of Comparative Zoology. The species is named after George Washington, as is the mountain.

**Description.** Female. Carapace brown, sternum dark brown. Coxae light brown,



Figures 131-137. *Araneus olivine* (Walckenaer). 131-133. Epigynum. 131. Ventral. 132. Lateral. 133. 134. Posterior. 135-137. Left male palpus. 135. Mesal. 136. Ventral. 137. Embolus.  
 Figures 138-151. *A. iveri* (Archer). 138-143. Epigynum. 138-140. (New Jersey). 141. (Alberta). 142. (Massachusetts). 143. (Saskatchewan). 144. Female abdomen. 145-151. Male palpus. 145-146. (Pennsylvania). 147, 148. (Michigan). 149, 147. Mesal. 146, 148. Ventral. 149-151. Embolus. 149. (Vermont). 150. (Michigan). 151. (Pennsylvania). 149, 150. With cap. 151. Without cap, slightly ventrolateral.  
 (Size indicators 0.5 mm, embolus tips 0.05 mm, abdomen 5 mm)

legs brown, indistinctly banded. Dorsum of abdomen with a folium and a black line between humps, darker anterior of line with a white cardiac mark and a transverse white line (Fig. 126). Venter of abdomen black with a white bracket on each side. Each side of abdomen has a black patch which fades toward the venter. The shape of the abdomen resembles that of most other species having humps; the humps are on the dorsum rather than the sides. Total length, 6.5 mm. Carapace, 3.5 mm long, 2.5 mm wide. First femur, 3.0 mm; patella and tibia, 4.0 mm; metatarsus, 2.3 mm; tarsus, 1.0 mm. Second patella and tibia, 3.5 mm; third, 2.2 mm; fourth, 1.0 mm.

Male. The coloration is like that of the female except that the legs are banded. The first coxa has a hook, the second lacks a spur. The second tibia is swollen and has strong setae. Total length, 5.0 mm. Carapace, 2.5 mm long, 2.0 mm wide. First femur, 2.9 mm; patella and tibia, 3.5 mm; metatarsus, 2.0 mm; tarsus, 0.7 mm. Second patella and tibia, 3.0 mm; third, 1.5 mm; fourth, 2.2 mm.

*Diagnosis.* The female differs from *A. corticarius* in having the humps of the abdomen dorsal rather than lateral (Fig. 126). The anterior section of the scape of the epigynum is posteriorly directed in *A. washingtoni* (Figs. 123, 124); in *A. corticarius* it is directed anteriorly and then folds back (Figs. 114–116). The male differs from *A. corticarius* by the dorsal position of the abdominal humps, by the much smaller conductor (Fig. 128), and the shorter median apophysis (Figs. 127, 128).

*Habits.* Emerton collected the specimens on low bushes. The label was written in India ink and at some later time Emerton pencilled "*corticaria*" behind the inked *Epeira*. The female from New Brunswick was collected on balsam fir (*Abies balsamea*).

*Distribution.* Newfoundland to New Hampshire (Map 5).

*Records. Newfoundland:* Gambo, 25. IV. 1949, ♀ (E. Palmén); Eddies Cove, west St. John Bay, 30. VII. 1949, ♀ (E. Palmén). *New Brunswick:* Green River Forestry Station, 22 July 1965, ♀; 18 July 1967, 2♂ (T. R. Renault). *New Hampshire:* 2♀, 2♂ paratypes collected with the holotype.

### *Araneus alsine* (Walckenaer)

#### Figures 131–137

*Aranea alsine* Walckenaer, 1802, Faune Parisienne, 2: 193. Type for the Paris, France, vicinity, lost. Wiehle, 1931, in Dahl, Die Tierwelt Deutschlands, 23: 83, figs. 119–123, ♀, ♂. Roewer, 1942, Katalog der Araneae, 1: 781.

*Epeira alsine*, — Wiehle, 1927, Z. Morphol. Ökol. Tiere, 8: 493.

*Araneus alsine*, — Loeket and Millidge, 1953, British Spiders, 2: 133, figs. 85d, 86d, ♀, ♂. Bonnet, 1955, Bibliographia Araneorum, 2: 429.

This Eurasian species, distributed from Europe to Kamchatka, has not been found in North America. It is very similar to *A. iviei* of North America. *Araneus alsine* is found on grasses of moist woods or clearings, and the hub of the web is about 15–20 cm above the ground. The rolled-up leaf or leaves which are used as a retreat are pulled up from the ground (Wiehle, 1927). A web with 20 spokes was illustrated by Wiehle (1931).

### *Araneus iviei* (Archer)

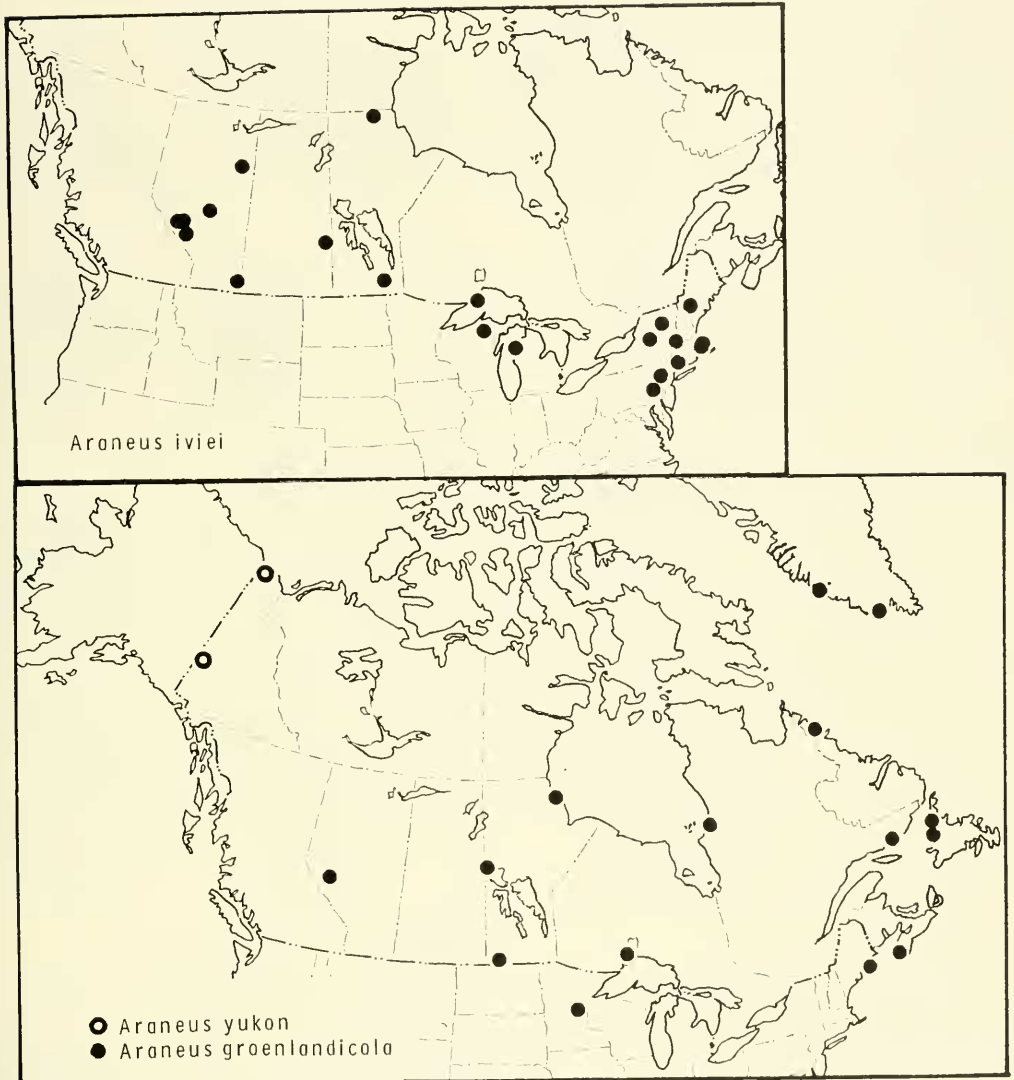
#### Figures 138–151; Map 6

*Aranea iviei* Archer, 1951, Amer. Mus. Novitates, 1487: 33, fig. 53, ♀. Female holotype from Keene Valley, Essex Co., New York, in the American Museum of Natural History, examined.

*Aranea sachimau* Archer, 1951, Amer. Mus. Novitates, 1487: 33, fig. 55, ♀. Female holotype from Norwell, Plymouth Co., Massachusetts, in the American Museum of Natural History, examined. NEW SYNONYMY.

*Description.* Female paratype of *A. iviei* from New Jersey. Carapace, sternum, legs orange-brown without any marking. Abdomen whitish with an orange cast, and with a few whitish spots framed by darker orange. Venter between epigynum and





Map 6. Distribution of *Araneus iviei* (Archer), *Araneus yukon* sp. n., and *Araneus groenlandicus* (Strand).

spinnerets has a white square with orange center. Abdomen lacks humps. Total length, 12 mm. Carapace, 5.0 mm long, 4.2 mm wide. First femur, 4.4 mm; patella and tibia, 5.4 mm; metatarsus, 3.2 mm; tarsus, 1.5 mm. Second patella and tibia, 4.9 mm; third, 2.9 mm; fourth, 4.6 mm.

Male from Michigan. Carapace and sternum brown, darker on each side. Legs

brown, very indistinctly marked. Dorsum of abdomen whitish with outline of a folium. Brownish venter has a light mark followed by a dark mark between epigastric furrow and spinnerets. Coxa without hooks or spurs. Second leg not modified. Total length, 6.7 mm. Carapace, 4.2 mm long, 3.2 mm wide. First femur, 4.9 mm; patella and tibia, 5.2 mm; meta-

tarsus, 3.6 mm; tarsus, 1.4 mm. Second patella and tibia, 4.2 mm; third, 2.9 mm; fourth, 4.1 mm.

*Variation.* Females vary from 8.5–12 mm in total length, carapace 4.1–5.0 mm long, 3.2–4.2 mm wide. Males varied from 5–7 mm in total length, carapace 3.6–4.2 mm long, 2.9–3.2 mm wide. In posterior view no two epigyna are exactly alike (Figs. 140, 142). Figure 142 illustrates a specimen designated as paratype of *A. sachiman* by Archer.

*Diagnosis.* *Araneus iviei* superficially resembles *A. trifolium*; the genitalia are unlike those of any other North American species but very similar to those of the Eurasian *A. alsine*. The epigynum, unlike that of any other North American species, has a strongly domed base anteriorly and is truncate posteriorly (Figs. 138, 141). In *A. iviei* the shape of the median septum in posterior view narrows dorsally toward the abdomen (Figs. 140, 142), while in *A. alsine* it widens into a flat plate more or less truncate toward the abdomen (Figs. 133, 134).

The male's palpal conductor has a distal "pocket" (Figs. 146, 148) unlike other Northern American *Araneus* species. It differs from *A. alsine* in the shape of the conductor, and in the shape of the embolus (Figs. 145–150).

*Habits.* The species has been collected from a cedar (*Thuja occidentalis*) swamp in Michigan, sweeping old fields in open forest vegetation on Isle Royale, on base of lodgepole pine (*Pinus contorta*) and in lodgepole woods in Alberta, and in conifer-aspens (*Populus tremuloides*) with pockets of black spruce (*Picea mariana*) with dense undercover of rosebushes, grasses, and sedges in the damp area, at Lake George, Alberta (R. E. Leech, personal correspondence).

*Distribution.* From Alberta southeast to Pennsylvania. The northernmost record is Riverton, Manitoba, the southernmost Lenhartsville, Berks Co., Pennsylvania (Map 6).

### *Araneus quadratus* Clerck Figures 152–158

*Araneus quadratus* Clerck, 1757, Svenska Spindlar, p. 27, pl. 1, fig. 3, ♀. Female holotype from Sweden in the Natural History Museum, Stockholm, lost. Locket and Millidge, 1953, British Spiders, 2: 130, figs. 84b, 85b, 86b, ♀, ♂. Bonnet, 1955, Bibliographia Araneorum, 2: 575.

*Aranca raamurii* Scopoli, 1763, Entomologia Carniolica, p. 393. Types from Austria. Scopoli's collection was destroyed about 1776. (Horn and Kahle, 1936, Entomol. Beihefte, 3: 252.) Wiehle, 1931, in Dahl, Tierwelt Deutschlands, 23: 79, figs. 115–118, ♀, ♂. Roewer, 1942, Katalog der Araneae, 1: 804.

*Epeira quadrata*.—Wiehle, 1927, Z. Morphol. Ökol. Tiere, 8: 496. Nielsen, 1932, Biology of Spiders, 2: 292.

*Note.* This European species closely related to *A. yukon* has not been found in America. Japanese specimens alleged to be *A. quadratus* were examined, but large differences in the shape of the conductor and median apophysis make me think neither specimen is correctly identified. *Araneus quadratus* reported from Greenland are *A. groenlandicolus* (Strand). The web is made in high grasses of moist areas, the center about 50 cm above the ground, and has about 20 spokes (Wiehle, 1931; Nielsen, 1932).

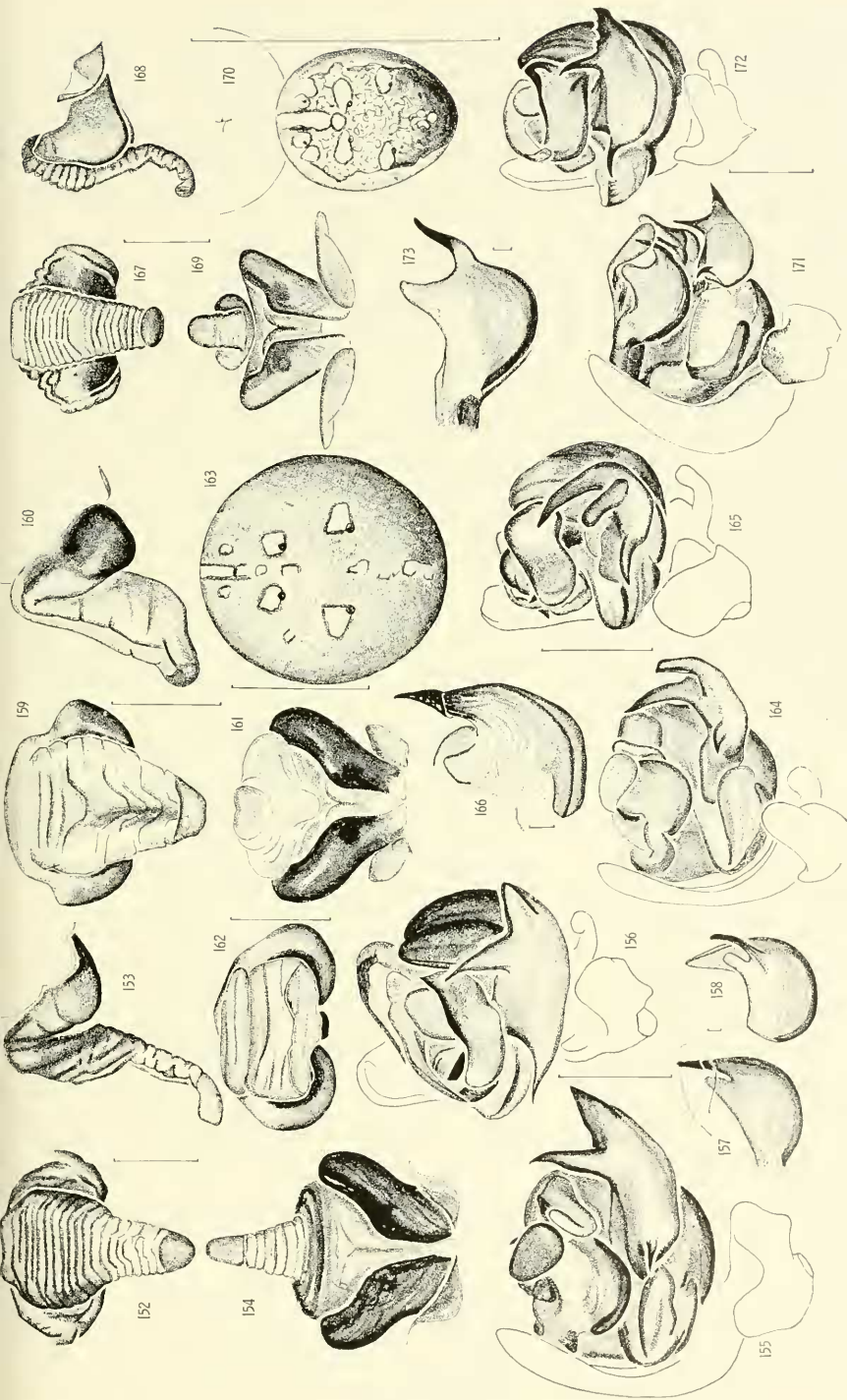
### *Araneus groenlandicolus* (Strand) Figures 159–166; Map 6

*Epeira quadrata*.—Sørensen, 1898, Vidensk. Meddel. Naturhist. Foren. København, 1898. Not *A. quadratus* Clerck.

*Aranca raamurii* var. *groenlandicola* Strand, 1906, Fauna Arctica, 4: 458. New name for specimens of *Epeira quadrata* described by Sørensen from Greenland. Female lectotype here designated from Ivigtut, Greenland, 15. VIII. 1889 (Lundbeck) in the Universitetets Zoologiske Museum, Copenhagen, examined.

*Aranca manitobae* Archer, 1951, Amer. Mus. Novitates, 1487: 37, figs. 51, 59, 62, ♂. Male holotype from The Pas, Manitoba, in the American Museum of Natural History, examined. NEW SYNONYMY.

*Description.* Female. Carapace light brown with median longitudinal darker band and a dark band near each margin. Distal tips of chelicerae brown. Labial



Figures 152-158. *Araneus quadratus* Clerck (Europe). 152-154. Epigynum. 152. Ventral. 153. Lateral. 154. Posterior. 155-158. Left male palpus. 155. Mesal. 156. Ventral. 157. 158. Embolus. 157. With cap. 158. Without cap.

Figures 159-166. *A. graenlandicus* (Strand). 159-162. Epigynum. 159-161. (Minnesota). 162. (Greenland). 159, 162. Ventral. 160. Lateral. 161. Posterior. 163. Female abdomen. 164-166. Male palpus. 164. Mesal. 165. Ventral. 166. Embolus with cap.

Figures 167-173. *A. yukan* sp. n. 167-169. Epigynum. 167. Ventral. 168. Lateral. 169. Posterior. 170. Male abdomen. 171-173. Male palpus. 171. Mesal. 172. Ventral. 173. Embolus without cap.

(Size indicators 0.5 mm, embolus tips 0.05 mm, for abdomens 5 mm)

endites almost black except anterior border. Sternum black with a small, anterior median light mark. Legs very strongly banded. Abdomen white or red with white dorsal spots (Fig. 163). Venter is dark in front of spinnerets, light behind epigynum, and has two longitudinal bands. Abdomen without humps. Total length, 9 mm. Carapace, 4.0 mm long, 3.3 mm wide. First femur, 3.5 mm; patella and tibia, 4.3 mm; metatarsus, 2.7 mm; tarsus, 1.1 mm. Second patella and tibia, 4.5 mm; third, 2.3 mm; fourth, 3.5 mm.

Male holotype. Carapace, legs light brown. Sternum light brown with median longitudinal white line. Abdomen all white with white pigment spots around spinnerets. Coxae without hooks or spurs. Tibia of second leg swollen and with strong spines. Total length, 6.1 mm. Carapace, 3.2 mm long, 2.6 mm wide. First femur, 3.2 mm; patella and tibia, 4.0 mm; metatarsus, 2.7 mm. Second patella and tibia, 3.0 mm; third, 1.9 mm; fourth, 2.9 mm.

*Variation.* The scape of the epigynum of most females is broken off (Fig. 162), apparently it tears when mating. Females varied from 9–12 mm in total length, males from 5.5–7.5 mm.

*Diagnosis.* *Araneus groenlandicolus* lacks humps on the abdomen. Females have been confused with *A. trifolium* because of the reddish coloration of the abdomen and the median dark carapace stripe; however, the epigynum of *A. groenlandicolus* is very different (Fig. 159–162). The epigynum has wider rims than that of *A. quadratus*; the inside edges of the rims are covered by the scape (Fig. 159) (often broken off). The male of *A. groenlandicolus* has strongly bent distal hooks on its median apophysis (Figs. 164, 165) differing from those of *A. quadratus* and *A. yukon* and other *Araneus* species.

*Habits.* Almost nothing is known about the habits of *A. groenlandicolus*, but it is assumed to prefer open ground to forest as do other species of *Araneus* with a

round abdomen. In Alberta it has been found in sedge.

*Distribution.* Alberta to Greenland and south to Minnesota and Maine (Map 6). Specimens examined from Greenland came from Ivigtut and Godthaabsfjord.

#### *Araneus yukon* sp. n.

Figures 167–173; Map 6

*Holotype.* Male from Snag, lat 62° 24', long 140° 22', Yukon Territory, 24 July 1948, in the American Museum of Natural History. The specific name is a noun in apposition.

*Description.* Female paratype. Carapace brown with darker median and lateral bands. Sternum very dark brownish black with median longitudinal line of white pigment. Legs brown with very distinct dark banding. Abdomen with a folium posteriorly, a median light longitudinal mark anteriorly. Venter light with two dark spots side by side and a dark ring around spinnerets. Spinnerets blackish brown. Abdomen oval to subspherical without humps. Total length, 10 mm. Carapace, 4.2 mm long, 3.5 mm wide. First femur, 4.0 mm; patella and tibia, 4.9 mm; metatarsus, 3.0 mm; tarsus, 1.4 mm. Second patella and tibia, 4.4 mm; third, 2.8 mm; fourth, 4.0 mm.

Male holotype. Carapace with indistinct markings. Sternum dark with a median white line. Leg banding indistinct. Dorsum of abdomen has two pairs of white spots anterior to a dark folium and an anterior longitudinal white mark (Fig. 170). Ventral dark spots are fused to each other and the posterior one to the dark ring around the spinnerets. There are no hooks or spurs on coxa. The second tibia is slightly swollen. Total length, 6.5 mm. Carapace, 3.4 mm long, 2.8 mm wide. First femur, 3.5 mm; patella and tibia, 4.4 mm; metatarsus, 3.0 mm; tarsus, 1.3 mm. Second patella and tibia, 3.4 mm; third, 2.0 mm; fourth, 3.2 mm.

*Diagnosis.* *Araneus yukon* palpus differs

from that of related *A. quadratus* in having teeth on the lower distal lobe of the median apophysis (Fig. 172) instead of a straight carina; the conductor of *A. yukon* is wider and the "upper" lobe of the embolus (left in Figs. 171, 173) is wider than in *A. quadratus* (Fig. 158). European specimens showed little variation in these characters.

*Habits.* Firth River, a locality in which the species is found, is on the north slope of the British Mountains, 25 miles from the Arctic Ocean. Although north of the tree line, pockets of spruce (*Picea* sp.) to 3–4 m high occur in sheltered spots along the creeks; probably the specimen was found in these (R. E. Leech, in letter).

*Records.* *Yukon Territory.* Female paratype collected with holotype; Firth River, British Mountains, ♀ paratype, 24. VII. 1956 (R. E. Leech) in the Canadian National Museum.

### *Araneus trifolium* (Hentz), Shamrock Spider Figures 174–182; Map 7

?*Epeira vulpecula* Walckenaer, 1841, *Histoire Naturelle des Insectes Aptères*, 2: 69. Syntypes are Abbot, *Georgian Spider Illustrations*, figs. 131, 356 from Georgia in the British Museum of Natural History, examined. A *nomen dubium* and a *nomen oblitum*.

?*Epeira approximata* Blackwall, 1846, *Ann. Mag. Natur. Hist.*, 17(1): 80. Specimen from vicinity of Toronto, lost. A *nomen dubium* and *nomen oblitum*.

*Epeira trifolium* Hentz, 1847, *J. Boston Soc. Natur. Hist.*, 5: 471, pl. 31, fig. 1, ♀. Types from Maine, destroyed. Emerton, 1884, *Trans. Connecticut Acad. Sci.*, 6: 306, pl. 33, fig. 8, pl. 35, figs. 13, 14, 21, 22, ♀, ♂. McCook, 1893, *American Spiders*, 3: 145, pl. 1, figs. 3–6, pl. 2, fig. 3, ♀, ♂. Kaston, 1948, *Bull. Connecticut Geol. Natur. Hist. Surv.*, 70: 258, figs. 823–825, 2047.

*Epeira aurcola* Hentz, 1847, *J. Boston Soc. Natur. Hist.*, 5: 471, pl. 31, fig. 2, ♀. Type from Maine, destroyed.

*Epeira trifolium* var. *candidans* McCook, 1893, *American Spiders*, 3: 146, pl. 1, fig. 4, ♀. Female holotype from California, lost, the color of the abdomen was yellowish-white.

*Aranea trifolium*, — Comstock, 1912, *The Spider Book*, p. 479, figs. 501–508, ♀; 1940, rev. ed., *The Spider Book*, p. 493, figs. 501–508, ♀. Roewer, 1942, *Katalog der Araneae*, 1: 863.

*Aranea gosogana* Chamberlin, 1920, *J. Entomol. Zool.*, 12: 8, pl. 4, fig. 6, ♀. Female holotype from desert region in California, in the Museum of Comparative Zoology, examined.

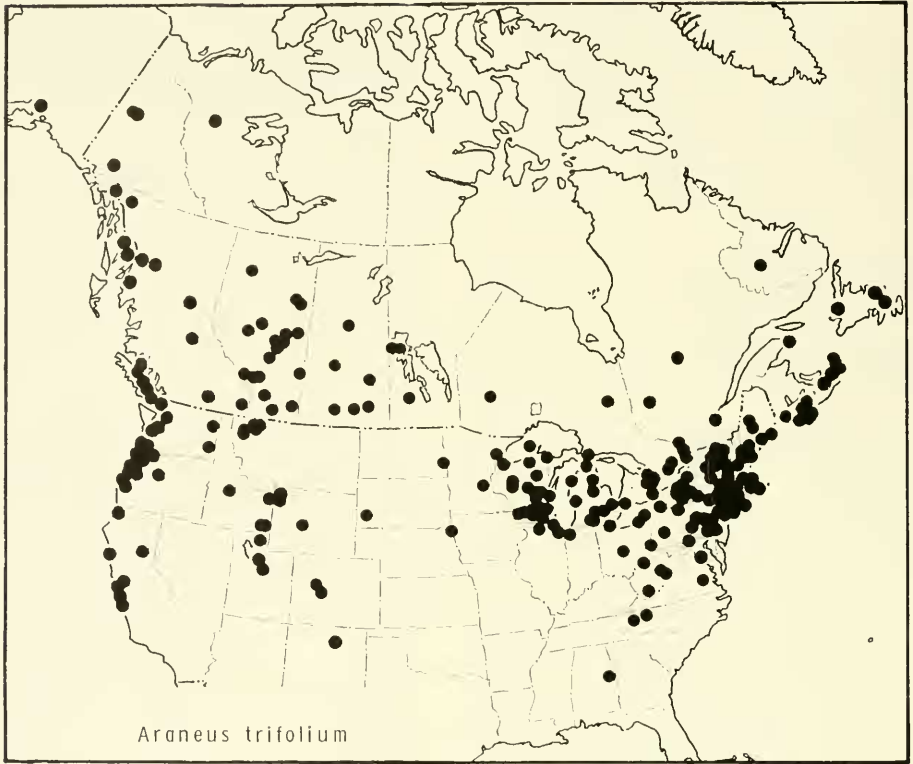
*Araneus trifolium*, — Bonnet, 1955, *Bibliographia Araneorum*, 2: 614.

*Note.* *Epeira jaspidata* Walckenaer, 1837, has been placed as a synonym, first by McCook: the type, Abbot, fig. 111, however, seems to have humps. Abbot's figure is either *A. nordmanni* or *A. bicentennarius*. However, Walckenaer indicated in the description of the figure that the abdomen was round.

*Description.* Female. Carapace brown with a lighter band on each side of a dark median longitudinal band; sides dark with a lighter brown border. Sternum dark brown. Legs brown with strongly marked darker bands. Dorsum of abdomen reddish with white spots (Fig. 177), venter usually reddish brown without markings in adult. A specimen from Ithaca, New York, measured 15 mm in total length. Carapace, 6.5 mm long, 5.5 mm wide. First femur, 6.3 mm; patella and tibia, 8.0 mm; metatarsus, 5.5 mm; tarsus, 1.7 mm. Second patella and tibia, 6.9 mm; third, 4.2 mm; fourth, 6.7 mm.

Male. Carapace, sternum and legs brown, abdomen whitish, sometimes all white, sometimes with ventral marks. None of the coxae have hooks or spurs. The tibia of the second leg is only slightly thicker than that of other legs. A specimen from Montana measured 7.5 mm in total length. Carapace, 4.2 mm long, 3.4 mm wide. First femur, 4.6 mm; patella and tibia, 5.1 mm; metatarsus, 3.5 mm; tarsus, 1.5 mm. Second patella and tibia, 4.5 mm; third, 2.7 mm; fourth, 3.9 mm.

*Variation.* Many specimens have the dorsum of the abdomen white. Total length of females varied between 9–20 mm, with carapace 4.0–6.8 mm long, 3.6–5.4 mm wide. Total length of males, 5–8 mm, with carapace 3.0–3.6 mm long, 2.5–3.0 mm wide.



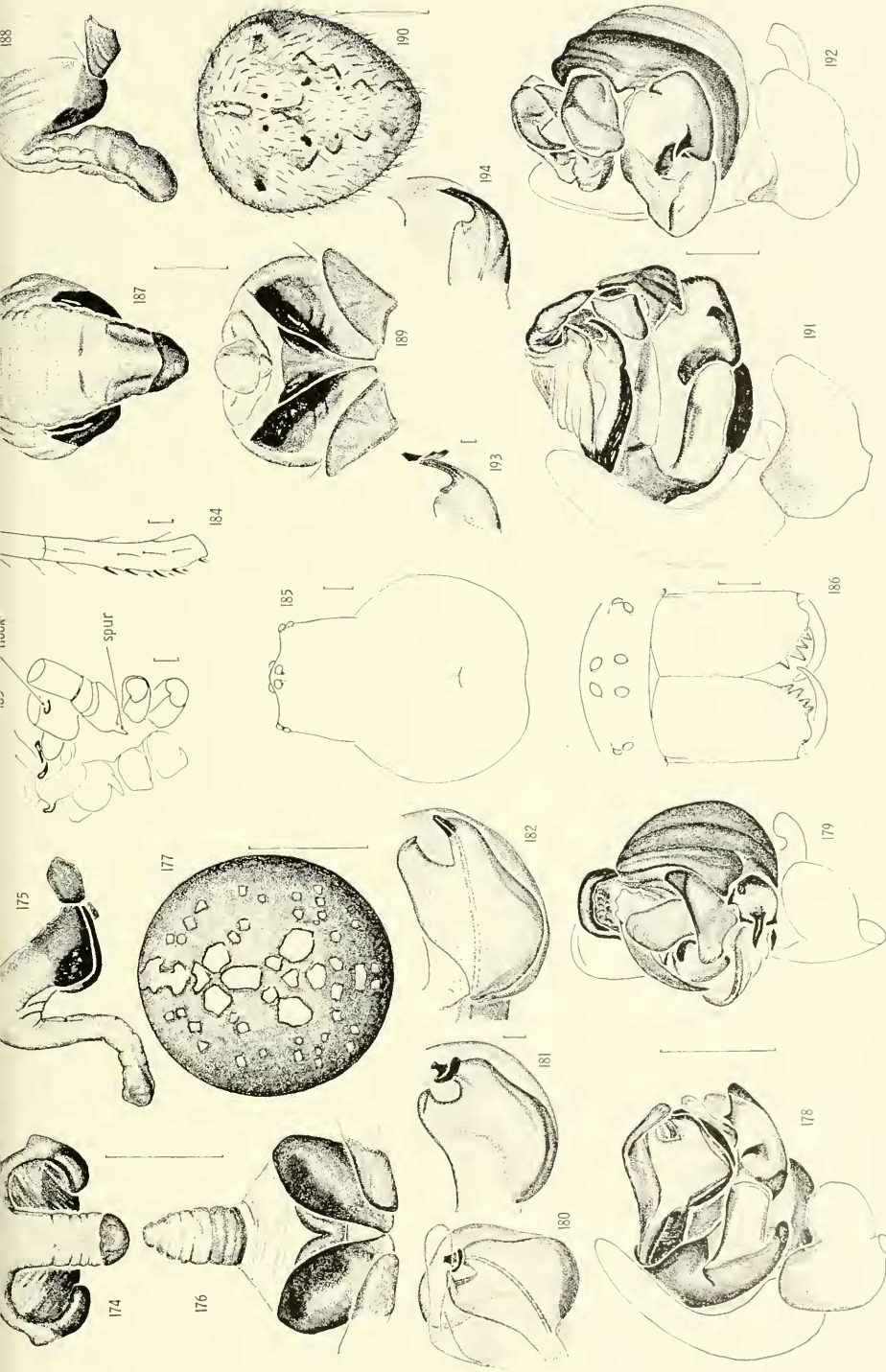
Map 7. Distribution of *Araneus trifolium* (Hentz).

*Diagnosis.* *Araneus trifolium* is not close to any other species, although females have been confused with *A. groenlandicolus* and *A. iviei* on account of the spherical abdomen, red coloration, and dark leg bands. But the epigynum of *A. trifolium* is very distinct: a scape (only rarely broken off) flanked on each side by a depression in the base; the margin of the depression and the depression itself are sclerotized and black posteriorly (Fig. 174).

The male palpus of *A. trifolium* has the embolus of an unusual shape (Figs. 178, 180-182); the embolus lamella is a huge flat scale with parallel sides of about the same visible area or larger than the small, narrow conductor (Fig. 179). The lamella, always easily seen, readily separates males from all other North American species. As no illustrations of the male palpus have

been readily available, many males of this common species are misidentified in collections.

*Habits.* *Araneus trifolium* is found in meadows and edges of fields making its web between herbaceous plants, often goldenrod (*Solidago* sp.), or shrubs, with the hub about 0.5-2 m off the ground. The web has about 20 spokes. The web and egg sac have been illustrated by Comstock (1912, 1940). During the recent years of drought the spiders disappeared completely from the fields around our house in Massachusetts but reappeared with the first wet season in summer of 1967, to reach unusual abundance in 1968 and 1969. Kaston (1947) describes the egg sacs after Scheffer as "white, about an inch in diameter and delicate enough for the mass of several hundred yellow eggs to show



Figures 174-182. *Araneus trifolium* (Hentzi). 174-176. Epigynum. 174. Ventral. 175. Lateral. 176. Posterior. 177. Female abdomen. 178-182. Left male palpus. 178. Mesal. 179. Ventral. 180-182. Embolus. 180, 181. With cap. 182. Without cap.  
 Figure 183. *A. marmareus* Clerck, male, cephalothorax subventral.  
 Figures 184-186. *A. diadematus* Clerck. 184. Male left patella-tibia, lateral. 185, 186. Female cephalothorax.  
 Figures 187-194. *A. cavaticus* (Keyserling). 187-189. Epigynum. 187. Ventral. 188. Lateral. 189. Posterior. 190. Female abdomen. 191-194. Male palpus. 191. Mesal. 192. Ventral. 193, 194. Embolus. 193. With cap. 194. Without cap.  
 [Size indicators, genitalia 0.5 mm, for embolus tips 0.05 mm, for other body parts 5 mm]

through. The young leave the egg sac in fall or spring." The egg sac is illustrated in Comstock, 1912 and 1940.

*Distribution.* *Araneus trifolium* is found from Alaska to southern California and northern Florida (Map 7).

*Araneus cavaticus* (Keyserling)

Plate 2; Figures 187–194; Map 8

*Epcira cavatica* Keyserling, 1882, Verh. Zool. Bot. Ges. Wien, 31: 269, pl. 11, fig. 1, ♀. Female holotype from a Kentucky cave, Carter Co., Kentucky (Sanborn, 1874) in the Museum of Comparative Zoology, examined.

*Epcira ciurea* Emerton, 1884, Trans. Connecticut Acad. Sci., 6: 302, pl. 33, fig. 10, pl. 35, figs. 7, 8, ♀. Female syntypes from Sable Chasm, New York, in the Museum of Comparative Zoology, examined.

*Aranea cavatica*, — Comstock, 1912, The Spider Book, p. 470, figs. 487–489, ♀. Roewer, 1942, Katalog der Araneae, 1: 859. Kaston, 1948, Bull. Connecticut Geol. Natur. Hist. Surv., 70: 251, figs. 798–799, ♀, ♂.

*Araneus cavaticus*, — Bonnet, 1955, Bibliographia Araneorum, 2: 453.

*Note.* *Aranea sinistra* F. P.-Cambridge, 1904, Biologia Centralia-Americana, 2: 510, pl. 48, fig. 21, ♀, from Omilteme, Mexico, may also be this species. The genitalia are similar but not identical. No specimens from intermediate areas were available. This species has been renamed *A. sinistrella* by Roewer, 1942, Katalog der Araneae.

*Description.* Female. Carapace yellow-brown, darker anterior of thoracic depression. Sternum dark brown. Coxae light yellow. Legs yellowish brown with darker brown bands. Abdomen gray to brown dorsally with an indistinct folium and anterior white mark (Fig. 190). Venter black between epigynum and spinnerets, with a white bracket on each side. Abdomen with two humps and covered by short hairs on dorsum, longer hairs on sides, and fine hair between humps. Total length of a specimen from Kentucky, 18 mm. Carapace, 7.3 mm long, 5.9 mm wide. First femur, 10.0 mm; patella and tibia, 11.8 mm; metatarsus, 8.4 mm; tarsus, 2.7 mm.

Second patella and tibia, 11.1 mm; third, 6.0 mm; fourth, 9.6 mm.

Male. Coloration like that of female, usually light. The tibia is not modified and the coxae lack hooks or spurs. A specimen from Kentucky measured 15 mm in total length. Carapace, 7.6 mm long, 6.7 mm wide. First femur, 13.5 mm; patella and tibia, 17.2 mm; metatarsus, 13.8 mm; tarsus, 3.4 mm. Second patella and tibia, 15.0 mm; third, 8.4 mm; fourth, 12.5 mm.

*Variation.* Females vary from 13–22 mm in total length, with the carapace 6.1–7.5 mm long, 5.4–6.1 mm wide. Males vary from 10–19 mm in total length, with the carapace 6.9–8.7 mm long, 5.2–7.8 mm wide.

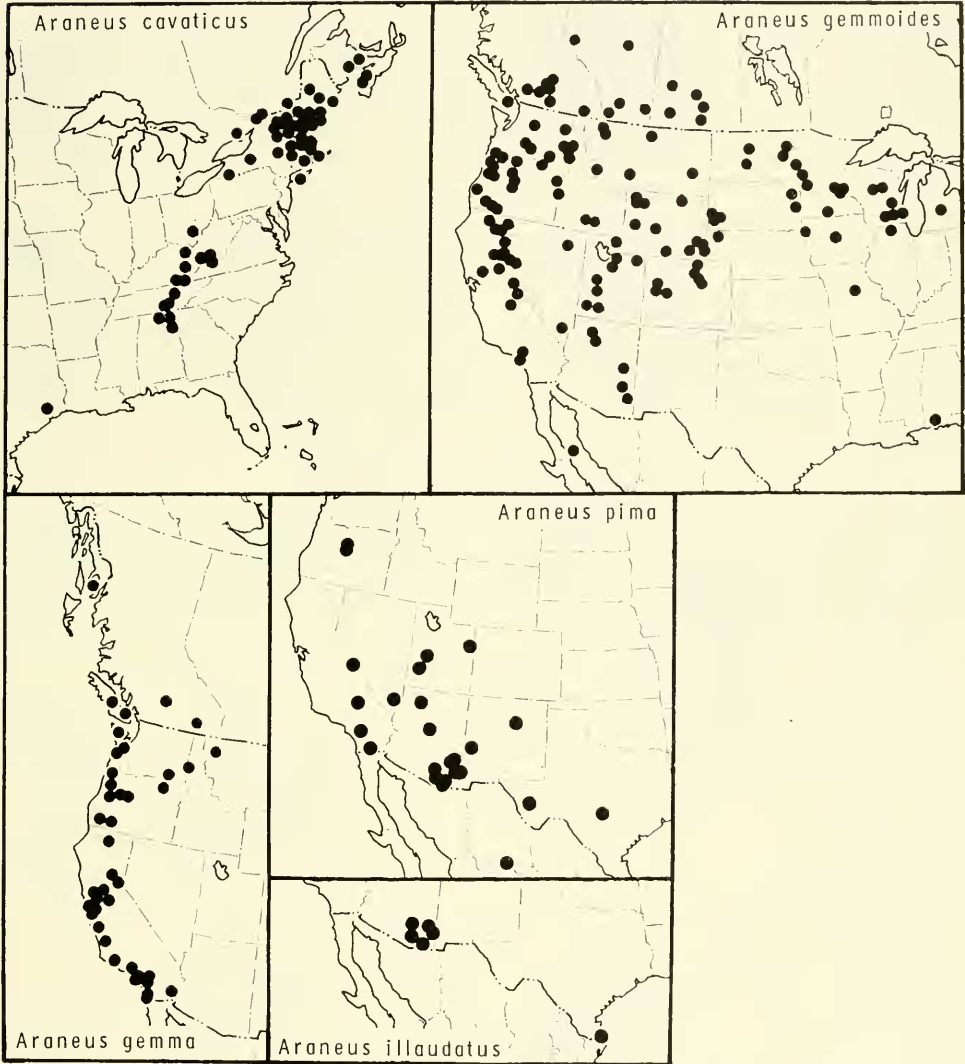
There is little color or morphological variation in this light-colored species.

*Diagnosis.* The epigynum of the female of this large humpbacked species can be confused with that of *A. nordmanni*. In posterior view the epigynum has a median sclerotized triangular piece (Fig. 189), that of *A. nordmanni* encloses a heart-shaped depression (Figs. 89, 92). The males can be recognized by their giant size and long legs. The large size separates males from those of the closely related Pacific coast *A. gemma* which has a somewhat similar embolus and terminal apophysis.

*Habits.* *A. cavaticus* makes its large webs with about 20 spokes (Plate 2) on barns, on porches, and bridges. One old collection from 1874 indicated that the spider was collected from under a natural bridge in Kentucky. It also has been reported from under overhanging cliffs, probably its original habitat. One male was collected while being fed on by a female *A. diadematus* in Ontario. Archer (1940, J. Alabama Acad. Sci., 12: 28) reports the species from caves in Alabama.

*Distribution.* *Araneus cavaticus* is found from New Brunswick, eastern Ontario and Nova Scotia to Texas. The southernmost record is of a pair collected at Houston, Texas (Map 8).





Map 8. Distribution of *Araneus cavaticus* (Keyserling), *Araneus gemmoides* Chamberlin and Ivie, *Araneus gemma* (McCook), *Araneus pima* sp. n., and *Araneus illaudatus* (Gertsch and Mulaik).

***Araneus gemmoides* Chamberlin and Ivie**  
**Plate 2; Figures 195–202; Map 8**

*Epeira gemma*. — Keyserling, 1892, Die Spinnen Amerikas, 4: 115, pl. 6, fig. 85, ♀. Not *A. gemma* McCook.

*Araneus gemmoides* Chamberlin and Ivie, 1935, Bull. Univ. Utah, Biol. Ser., 2(8): 22, pl. 10, fig. 80, ♀. Female holotype from Salt Lake City belonging to the Utah collection, kept at

the American Museum of Natural History, examined. Bonnet, 1955, Bibliographia Araneorum, 2: 507.

*Aranea gemmoides*. — Roewer, 1942, Katalog der Araneae, 1: 860.

*Araneus canmoris* Schenkel, 1950, Verh. Naturf. Ges. Basel, 61: 65, ♀. Female lectotype, here designated, from Canmore, Banff National Park, Canada, in the Naturhistorisches Museum Basel, examined. NEW SYNONYMY.

*Description.* Female from Wisconsin. Carapace light brown, sternum brown with a median light longitudinal streak. Coxae yellowish. Legs yellow-brown, with indistinct darker bands. Dorsum of abdomen light grayish brown with almost no pattern at all. Venter with two longitudinal dark marks behind epigynum and two light marks in front of spinnerets. Total length, 15 mm. Carapace, 4.6 mm long, 4.2 mm wide. First femur, 4.9 mm; patella and tibia, 5.9 mm; metatarsus, 3.7 mm; tarsus, 1.5 mm. Second patella and tibia, 5.5 mm; third, 3.0 mm; fourth, 4.9 mm.

Male from Idaho. Coloration almost like that of female. Abdomen with remains of outline of a folium and an anterior median dorsal light streak and humps large. Coxae, legs not modified. Total length, 8 mm. Carapace, 4.5 mm long, 3.5 mm wide. First femur, 5.7 mm; patella and tibia, 6.7 mm; metatarsus, 4.5 mm; tarsus, 1.5 mm. Second patella and tibia, 5.7 mm; third, 3.5 mm; fourth, 4.9 mm.

*Variation.* Total length of females varied from 13–25 mm; carapace 6.3–8.5 mm long, 5.0–7.5 mm wide. Total length of males 5.4–7.9 mm; carapace 3.2–4.3 mm long, 2.6–3.5 mm wide.

This species, unlike *A. gemma*, shows little variation except in color. Sometimes there is a distinct folium, sometimes not, and there may be a white cardiac mark. Only on the Pacific coast where it is in contact with the very similar *A. gemma* are some specimens dark. A single British Columbia specimen was black like *A. saevus*.

*Diagnosis.* The very tiny epigynum with a triangular scape (Fig. 195) readily separates *A. gemmoides* from other species, except for some *A. gemma* which may be hybrids. Males have a small bulb barely larger than the tibia (Figs. 199, 200); these proportions separate males from *A. gemma*. The male of *A. gemmoides* is much smaller in size than that of *A. cavaticus*.

*Habits.* The habitat of this species is similar to that of the eastern *A. cavaticus*.

I have collected it from under eaves of houses and on barns in Wisconsin that accommodated its huge web with about 20 spokes (Plate 2). But in the west it seems to have been collected in lodgepole (*Pinus contorta*) woods, and on the Pacific coast on houses. It has been found in natural situations in cave entrances, rocky ledges, and one record is from Manzanita chaparral, 1100 m, San Gabriel C., Los Angeles Co., California (L. Pinter).

The egg sac of *A. gemmoides* made in the laboratory is a fluffy, loosely woven sphere of orangish silk, 2 cm in diameter. A color illustration can be found in Gertsch (1949, *American Spiders*, Van Nostrand).

*Distribution.* *Araneus gemmoides* is found from British Columbia to Wisconsin, south to Missouri and Arizona (Map 8). It appears rare along the Pacific coast. Isolated records are: Michigan, Rose Lake, Clinton Co. (D. E. Bixler); Silver Hill, Alabama, Sept. 1945 (S. Nelson); and San Lorenzo Island [Baja California].

*Araneus gemma* (McCook)  
Figures 203–215; Map 8

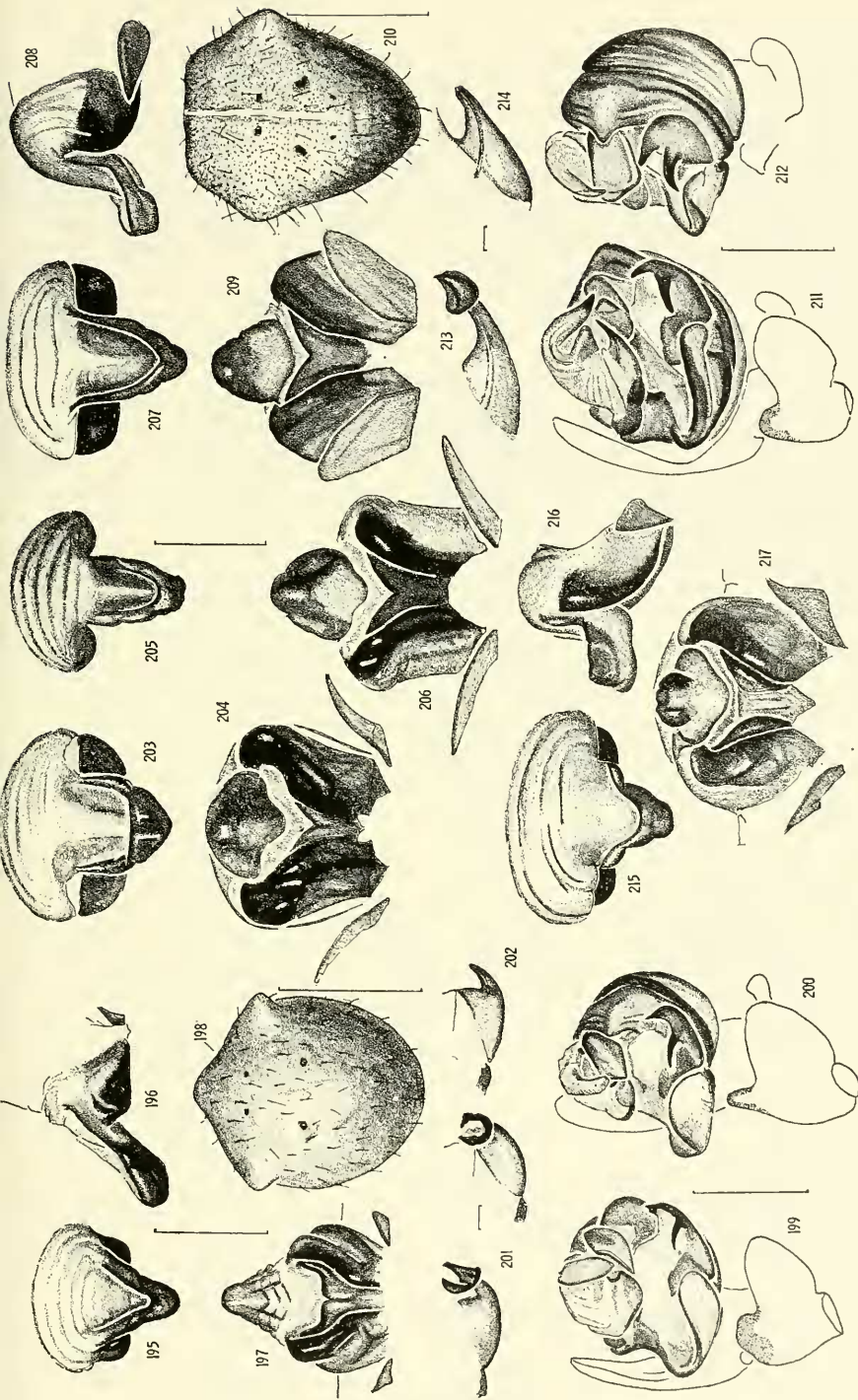
*Epeira gemma* McCook, 1888, Proc. Acad. Natur. Sci. Philadelphia, p. 193, figs. 1, 2, ♀. Female lectotype here designated from California in the Philadelphia Academy Natural Sciences, examined. 1894, *American Spiders*, 3: 182, pl. 9, figs. 1, 2, pl. 10, fig. 6, ♀, ♂.

*Araneus gemmus*, — Chamberlin and Ivie, 1935, Bull. Univ. Utah, Biol. Ser., 2(8): 21, pl. 10, fig. 79, ♀.

*Araneus pinus* Chamberlin and Ivie, 1935, Bull. Univ. Utah, Biol. Ser., 2(8): 22, pl. 10, fig. 81, ♀. Female holotype from Fillmore, California, in the University of Utah collection kept at the American Museum of Natural History, examined. NEW SYNONYMY.

*Araneus gemma*, — Bonnet, 1955, *Bibliographia Araneorum*, 2: 506.

*Note.* As pointed out first by Chamberlin and Ivie, McCook's description is a composite. The two syntypes are different species. One is clearly the common species in the San Diego, California, area, the type locality. The other is probably the



Figures 195-202. *Araneus gemmoides* Chamberlin and Ivie. 195-197. Epigynum. 195. Ventral. 196. Lateral. 197. Posterior. 198. Female abdomen. 199-202. Left male palpus. 199. Mesal. 200. Ventral. 201, 202. Embolus. 201. With cap. 202. Without cap.  
 Figures 203-214. *A. gemma* (McCook). 203-209. Epigynum (California). 203, 205, 207. Ventral. 208. Lateral. 204, 206, 209. Posterior. 210. Female abdomen. 211-212. Male palpus. 211. Mesal. 212. Ventral. 213, 214. Embolus. 213. With cap. 214. Without cap.  
 Figures 215-217. Epigynum of suspected cross *A. gemmoides* × *A. gemma*. (Size indicators 0.5 mm, for embolus tips 0.05 mm, for abdomens 5 mm)

same as what is called *A. pima* here. Other specimens in the McCook collection were *A. gemmoides*. The specimen which may be *A. pima* was not chosen lectotype because it either has the wrong collecting locality or comes from the very border of its range. Also the specimen appeared to be an atypical *A. pima*.

To favor stability of names, the other specimen was chosen lectotype even though as a result *A. pirus* will have to be synonymized. The range of the species whose name is now *A. gemma* is essentially that given by McCook and also McCook's description matches this species. *Araneus gemma* of Chamberlin and Ivie is certainly this species although the specimens could not be located. The name *A. gemma* has at times been used for *A. pima* on collecting vials only. The name *gemma* is a noun in apposition; its ending does not change with the gender of the genus (Bonnet, 1955).

*Description.* Female from California. Carapace maculated brown with some gray pattern. Legs yellowish, indistinctly banded brown. Abdomen brownish with a median longitudinal white line, or line absent. Venter with a black band enclosed by white brackets. Abdomen with large humps (Fig. 210). Total length, 12 mm. Carapace, 5.3 mm long, 4.6 mm wide. First femur, 5.9 mm; patella and tibia, 8.2 mm; metatarsus, 5.0 mm; tarsus, 1.9 mm. Second patella and tibia, 8.0 mm; third, 4.6 mm; fourth, 6.8 mm.

Male. Carapace, sternum, legs yellow-brown. Abdomen with a folium and anterior median white mark. Venter gray with a white bracket on each side. First coxa with a small tubercle on distal margin. Second tibia not modified. Total length, 8 mm. Carapace, 4.2 mm long, 3.3 mm wide. First femur, 5.9 mm; patella and tibia, 7.0 mm; metatarsus, 4.6 mm; tarsus, 1.7 mm. Second patella and tibia, 6.0 mm; third, 3.3 mm; fourth, 4.9 mm.

*Variation.* Females vary 9–19 mm in total length; carapace 4.4–6.4 mm long,

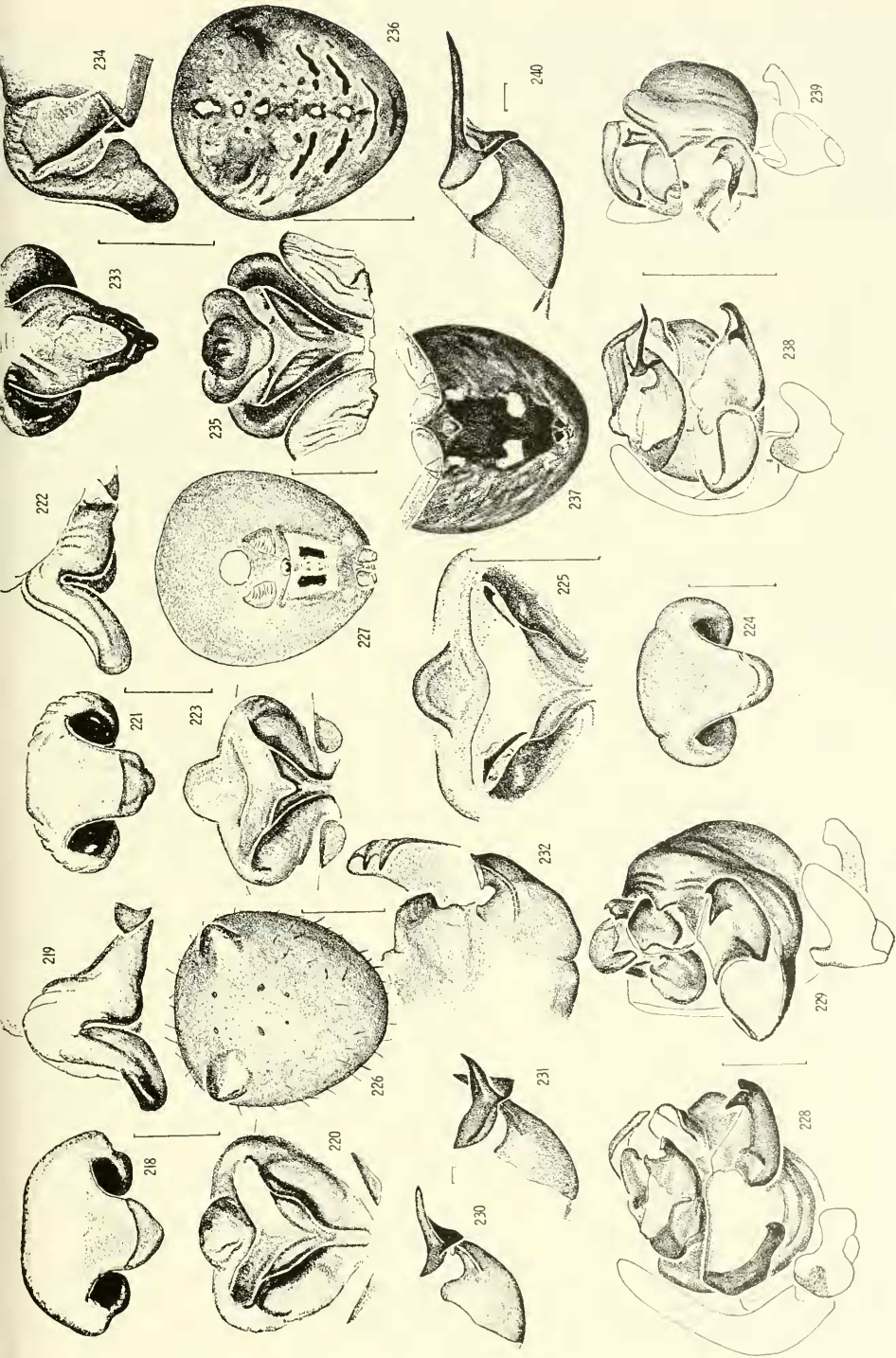
3.8–6.1 mm wide. Males vary 5.8–8.5 mm in total length; carapace 3.1–4.5 mm long, 2.5–3.6 mm wide.

The color varies in alcoholic specimens from light gray to almost black, some have two bars on the venter. Hardly two specimens have similar epigyna. It is believed that the species hybridizes with *Araneus gemmoides* and introgression is taking place. The male palpi, similar to those of *A. gemmoides* except for proportions, were not carefully studied for variation. (See introduction under species problems.)

*Diagnosis.* The short scape of the epigynum differs from that of related species in having a median ridge (Figs. 203, 205, 207, 208). But some females cannot be separated from *A. gemmoides*. (See Variation above and introduction under species problems.) The males are much smaller in size than those of the eastern *A. cavaticus*. The palpus has a larger bulb and smaller tibia (Figs. 211, 212) than the palpus of *A. gemmoides*. The upper surface of the embolus differs (Figs. 211, 213, 214) from that of *A. gemmoides* and the terminal apophysis is more pointed.

*Note.* McCook when describing *A. gemma* must have noted the problems of variation and applied one name to *A. gemmoides* and *A. gemma*. Presumably he could not readily separate the specimens which he had from California. Chamberlin and Ivie having smaller collections at hand used *gemma* for some specimens (Chamberlin and Ivie, 1935, fig. 79) and called others *A. pirus* (Chamberlin and Ivie, 1935, fig. 81), a reasonable judgment if only very few specimens are examined.

*Habits.* Little is known of the habits of *A. gemma*, although they are probably the same as those of *A. cavaticus* and *A. gemmoides*. One specimen was collected on a redwood (*Sequoia sempervirens*) trunk, San Jose, California. One from a porch at Walla Walla, Washington, others from Moscow, Idaho, came in the same collection with *A. gemmoides*. One *A. gemma* was collected from a hole in an olive tree



Figures 218-232. *Araneus pima* sp. n. 218-225. Epigynum. 218-220. (Santa Rita Mts., Arizona). 221-223. (San Bernardino Co., California). 224. (Jefferson Co., Oregon). 218, 221, 224. Ventral. 219, 222. Lateral. 220, 223, 225. Posterior. 225. Containing suspected *A. illoudatus* embolus caps. 226, 227. Female abdomen. 226. Dorsal. 227. Ventral. 228-232. Left male palpus. 228. Mesal. 229. Ventral. 230-232. Embolus. 230, 231. With cap. 232. Without cap.

Figures 233-240. *A. illoudatus* (Gertsch and Mulaik). 233-235. Epigynum. 233. Ventral. 234. Lateral. 235. Posterior. 236, 237. Female abdomen. 236. Dorsal. 237. Ventral. 238-240. Male palpus. 238. Mesal. 239. Ventral. 240. Embolus with cap.

[Size indicators 0.5 mm, for embolus tips 0.05 mm, for abdomens 5 mm]

(*Olea europea*) feeding on a ruby-crowned kinglet (*Regulus calendula*) which was caught in its web (Pasadena, California, 5 November, 1942, Mrs. H. Michener).

*Distribution.* *Araneus gemma* is found from southern Alaska to southern California; the northernmost collections are from Ketchikan, Alaska, the easternmost from Bigfork, Montana (Map 8).

*Araneus pima* sp. n.

Plate 1, 4; Figures 218–232; Map 8

*Holotype.* Female holotype from Madera Canyon, Santa Rita Mountains, Pima Co., Arizona, 29 July 1958 (A. Ross) in the American Museum of Natural History. The specific name is a noun in apposition after the type locality.

*Description.* Female from Arizona. Carapace brown. Sternum brown with median area lighter. Legs brown. Abdomen gray-brown, without folium, the venter with a pair of parallel longitudinal black bars surrounded by white (Plate 4, Fig. 227). Humps very large. Abdomen covered by sparse long setae. Total length, 20 mm. Carapace, 8.0 mm long, 6.4 mm wide. First femur, 7.8 mm; patella and tibia, 9.8 mm; metatarsus, 6.5 mm; tarsus, 2.2 mm. Second patella and tibia, 9.6 mm; third, 5.5 mm; fourth, 8.9 mm.

Male from Arizona. Coloration like that of female except that legs show some banding and abdomen has a folium and anterior median longitudinal white line. Coxae and second tibia are not modified. Total length, 9 mm. Carapace, 5.5 mm long, 4.3 mm wide. First femur, 7.0 mm; patella and tibia, 10.0 mm; metatarsus, 5.9 mm; tarsus, 1.9 mm. Second patella and tibia, 7.6 mm; third, 4.2 mm; fourth, 6.4 mm.

*Variation.* The largest female measured 27 mm in total length; the carapace was not measured. Another male measured 5.2 mm in total length, carapace, 2.5 mm long, 2.0 mm wide. Although what are believed to be tips of *A. illaudatus* emboli are found

at times in the groove of the epigynum, the species do not seem to hybridize. There is not much variation except in length of scape.

*Diagnosis.* The flat rounded scape of the epigynum (Figs. 218, 221, 224) with a deep wide groove under it (Figs. 220, 223) distinguishes females of *A. pima* from *A. gemmoides* and *A. gemma*. The males are distinguished from *A. gemma* by the shape of the median apophysis, by having the median spine joined with the distal one, and by the truncate embolus (Figs. 228, 232). The more blunt terminal apophysis (Figs. 228, 229) and the shape of the median apophysis with the spines joined distinguishes *A. pima* from *A. illaudatus*.

*Habits.* *Araneus pima* has been collected under eaves of buildings of the Southwestern Research Station, near Portal, Arizona, under a bridge in New Mexico, along a trail in the Grand Canyon, and in cave entrance of O.T.L. cave north of Alpine, Texas.

The eggs are in an oval mass 2 cm long, 1.8 cm wide, 1 cm thick. About 700 eggs were estimated on the surface of the clump of eggs, which must have contained more than a thousand. A loose pink woolly web 4–5 cm<sup>2</sup> surrounded the eggs, quite similar to the egg sac of *A. gemmoides* (Plate 1).

*Note.* In some collections specimens of this species had been incorrectly determined as *A. gemma*. It is not *A. gemma* of McCook nor of Chamberlin and Ivie (1935, fig. 79).

*Distribution.* *Araneus pima* is found from eastern California to Utah and Arizona. Localities at the border of the range are: Gateway, Oregon, Kerrville, Texas (Map 8). Female and male paratypes from the type locality have been collected.

*Araneus illaudatus* (Gertsch and Mulaik)

Figures 233–240; Map 8

*Aranea illaudata* Gertsch and Mulaik, 1936, Amer. Mus. Novitates, 863: 19, figs. 36, 37, ♂. Male holotype from Edinburg, Texas, in the American Museum of Natural History, examined. Archer,

1951, Amer. Mus. Novitates, 1487: 36, fig. 74, ♂ (not fig. 67 ♀).

*Note.* Archer (1951) matched the wrong female to the male described previously as *A. illaudatus*. Archer's female is an *A. nordmanni* and as Archer correctly points out is quite different from females of *A. cavaticus* group.

*Description.* Female from Arizona. Carapace yellowish with dark brown mottling. Sternum black, coxae yellowish, legs banded yellowish and dark brown. Dorsum of abdomen with two rows of transverse black marks pointing posteriorly towards the middle on a mottled background (Fig. 236). A median dorsal longitudinal line of white spots not always present. Venter with a black band between pedicel and spinnerets containing a pair of prominent white spots side by side and sometimes a smaller pair of white spots. Abdomen with two humps. Total length, 11 mm. Carapace, 3.8 mm long, 3.4 mm wide. First femur, 4.2 mm; patella and tibia, 5.5 mm; metatarsus, 3.7 mm; tarsus, 1.4 mm. Second patella and tibia, 5.0 mm; third, 3.0 mm; fourth, 4.9 mm.

Male holotype. Carapace brown. Sternum brown. Legs yellow-brown. Abdomen yellow-brown. Dorsum with distinct folium, anterior border has a white cross. Venter with a pair of white spots side by side. Coxae and second tibia not modified. The abdomen has two distinct humps. Total length, 3.6 mm. Carapace, 2.0 mm long, 1.4 mm wide. First femur, 2.5 mm; patella and tibia, 2.8 mm; metatarsus, 1.8 mm; tarsus, 0.9 mm. Second patella and tibia, 2.3 mm; third, 1.3 mm; fourth, 2.0 mm.

*Diagnosis.* The female scape is constricted at its base and almost diamond shaped (Fig. 233), quite different from that of the related *A. pima* (Figs. 218, 221, 224). The male palpus has the spines of the median apophysis farther apart and the terminal apophysis more pointed and twisted (Figs. 238, 239) than that of

*Araneus pima*. The cap of the embolus is the longest of any *Araneus* species, longer than the embolus (Fig. 240).

*Habits.* One female collected in the Chiricahua Mts., Arizona, at 7500–9000 feet [2300–2900 m] had its web on brush under pines in August.

*Distribution.* *Araneus illaudatus* is found from western Texas to Arizona (Map 8).

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